# SANITARY TREATMENT PLANT
# EVALUATION STUDY
# ROCKY FLATS PLANT

Task 10
of the
Zero-Offsite Water-Discharge Study

Prepared For:

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## EXECUTIVE SUMMARY

This final report has been prepared for one of several studies being conducted for, and in conjunction with, a Zero-Offsite Water-Discharge Plan for Rocky Flats Plant (RFP) in response to Item C.7 of the Agreement in Principle (AIP) between the Colorado Department of Health (CDH) and the U.S. Department of Energy (DOE) (Agreement in Principle, 1989). The CDH/DOE Agreement Item C.7 states "Source Reduction and Zero Discharges Study: Conduct a study of all available methods to eliminate Rocky Flats discharges to the environment including surface waters and ground water. This review should include a source reduction review" (AIP,1989, p.8).

Specifically, this study examines the Sanitary Treatment Plant (STP) and evaluates the existing plant's performance abilities; the need for upgrading the existing plant or new facilities; the need for increasing plant capacity to meet future demands; and impacts of to meet the current and future stream/effluent standards (scheduled for finalization in 1991).

Effluent Quality Determination

The STP discharges to Pond B3 with subsequent release to Pond B5, both of which are located on Walnut Creek. Activated carbon treatment of the contents of Pond 5 is presently provided prior to their release to Walnut Creek. The STP discharge is regulated under a National-Pollutant Discharge Elimination System (NPDES) permit to aid in meeting the existing Walnut Creek stream standards. Stream standards for this segment of Walnut Creek, as established by the Water Quality Control Division of the CDH, require that certain organic compounds be maintained at concentrations 1,000,000 times less than existing detection limits. Actual compliance is impossible to determine because the standards are below the detection limits. For this reason, the standards effectively preclude future discharge and require reuse/recycle/zero-discharge of the STP effluent.

This study assumes that STP effluent will be discharged to Walnut Creek. Two related studies, Recycle of Treated Sewage/Process Wastewater - Task 11/13 and Reverse Osmosis and Mechanical Evaporation Study - Task 12 (ASI, 1990b and ASI, 1990c, respectively) which are subordinate to the Zero-Offsite Water-Discharge Study discuss the features of recycling treated wastewater for the purpose of zero discharge. (Task 11, Process Wastewater Reuse, has been combined with Task 13, Recycle of Treated Sewage, into one document.)

Discharge under the anticipated future RFP NPDES permit will require nitrification and denitrification. Existing facilities at the STP are not capable of meeting this requirement. For example, the anticipated NPDES limits will reduce the allowable amount of ammonia nitrogen from 10 to 1 mg/l and the nitrate limit from 20 to 10 mg/l. The anticipated effluent limits under the NPDES permit are given in the Table 1.

Current Conditions

Sanitary wastes from about 6,200 employees working in the personnel security zone (PSZ) and the non PSZ are equalized at Building 990 and treated at the STP. The average daily influent flow is approximately 220,000 gpd during the week and 131,000 gpd over the weekend, or about 35 gallons per employee per day.

**Table 1**
**Anticipated NPDES Permit Effluent Limits**

| | mg/l | | |
|---|---|---|---|
| Parameter | 30-Day Avg. | 7-Day Avg. | Daily Max. |
| $BOD_5$ | 10 | | 25 |
| TSS | 30 | 45 | |
| Fecal Coliform #100/ml | 200 | 400 | |
| Nitrates as N | 10 | 10 | |
| Ammonia as N | 1 | 1 | |
| Total Residual Chlorine | | | .003 |
| Total Chromium | 0.05 | | 0.10 |
| Total Phosphorus as P | 8 | | 12 |
| pH, units | Shall remain between 6.0 and 9.0 | | |
| Oil and Grease | Shall be less than 10 mg/l and no visible sheen or floating oil | | |

Influent wastewater quality data was collected during a supplemental sampling program conducted between July 25 and August 24, 1990. Daily composite samples were collected and tested for $BOD_5$ ammonia, TKN, alkalinity, temperature and pH. The analytical results indicated a high degree of variability due primarily to weekday/weekend workforce levels. The data are summarized in Table 2.

**Table 2**
**Summary of Daily Composite Sample Results**
**(Between July, 25 and August 24, 1990)**

| mg/l | | | | | | |
|---|---|---|---|---|---|---|
| | $BOD_5$ | Ammonia-N | TKN | Alkalinity | Temp,°C | pH |
| Avg. | 82.5 | 20.5 | 27.0 | 117.6 | 21.0 | 7.6 |
| Max. | >180 | 65 | 61 | 170 | 24 | 8.0 |
| Min. | 19 | 5 | 3 | 80 | 19 | 7.0 |

Sampling and analyses were also conducted for metals and organic compounds. The STP is currently being modified to address upgrades identified earlier, under a separate investigation.

Future Conditions

In the future, the workforce at the RFP could range between 3,000 and 9,000 people. Based on this projection, it was determined that required future STP capacity will be between 125,000 gpd and 400,000 gpd.

Recommended Alternative

Due to the highly variable nature of future hydraulic/organic loads and nitrification/denitrification requirements, a modification to the existing STP incorporating new activated sludge tankage which operates in a batch mode is the recommended alternative. Additional improvements are recommended including influent solids grinding, pumping, chemical feed and flotation/filtration clarification as shown on Figure 6. These improvements comprise the most cost effective/efficient system consistent with projected discharge limits. In the event discharge is not permitted because of future stream standards, the recommended alternative is consistent with the reuse/recycle/zero-discharge recommendations described in Task 11/13; as well as the planned

STP upgrades currently under construction. The recommended alternative is more fully described in Section 5.

# 1.0 INTRODUCTION

## 1.1 STUDY PURPOSE AND SCOPE

This final report has been prepared for one of several studies being conducted for, and in conjunction with, a Zero-Offsite Water-Discharge Plan for Rocky Flats Plant (RFP) in response to Item C.7 of the Agreement in Principle (AIP) between the Colorado Department of Health (CDH) and the U.S. Department of Energy (DOE) (Agreement in Principle, 1989). The CDH/DOE Agreement Item C.7 states "<u>Source Reduction and Zero Discharges Study</u>: Conduct a study of all available methods to eliminate Rocky Flats discharges to the environment including surface waters and ground water. This review should include a source reduction review" (AIP,1989, p.8).

Specifically, this study examines the Sanitary Treatment Plant (STP) in the following context:

(1) the existing plant's performance abilities;

(2) the need for upgrading the existing plant or providing new facilities;

(3) the need for increasing plant capacity to meet future demands, and

(4) impacts of the current and future stream/effluent standards (scheduled for finalization in 1991).

This study also documents influent wastewater characteristics and assesses existing treatment plant factors which limit performance. The existing NPDES permit is examined and the factors influencing new permit requirements are discussed. Wastewater quantity and quality characteristics are projected and a recommended treatment alternative is outlined. This study also provides preliminary design data in sufficient detail to assist in the design of recommended facilities.

This study assumes that STP effluent will be discharged to Walnut Creek. Two related studies Recycle of Treated Sewage/Process Wastewater Reuse - Tasks 11/13 (ASI, 1990b) and Reverse Osmosis/Mechanical Evaporation - Task 12 (ASI, 1990c), which are subordinate to the Zero-Offsite Water-Discharge Study, discuss the recycling of treated wastewater.

## 2.0 EFFLUENT QUALITY DETERMINATION

### 2.1 WASTEWATER DISCHARGE PERMIT

The Sanitary Treatment Plant (STP) discharges to Pond B-3 and then Pond B-5 on Walnut Creek. Pond B-5 water is currently being pumped through granular activated carbon prior to discharge offsite in accordance with local and state approval. The current NPDES permit, permit number CO-0001333, expired on June 30, 1989. (Section 3.4 outlines the plant's recent operating history). Under current load and existing NPDES permit conditions, effluent requirements are being met. Effluent limitations specified in the NPDES Permit CO-0001333 are shown n Table 3.

**Table 3**

**NPDES Permit No. CO-0001333 Effluent Limits**

| mg/l | | | |
|---|---|---|---|
| Parameter | 30-Day Avg. | 7-Day Avg. | Daily Max. |
| $BOD_5$ | 10 | N/A | 25 |
| TSS | 30 | 45 | N/A |
| Fecal Coliform #100/ml | 200 | 400 | N/A |
| Nitrates as N | 10 | 20 | |
| Total Residual Chlorine | N/A | N/A | 0.5 |
| Total Chromium | 0.05 | N/A | 0.10 |
| Total Phosphorus as P | 8 | N/A | 12 |
| pH, units | Shall remain between 6.0 and 9.0 | | |
| Oil and Grease | Shall be less than 10 mg/l and no visible sheen or floating oil | | |

Since June 30, 1989, the STP has been operating under an administrative extension of the existing NPDES permit. The existing permit conditions will continue in force until a new

NPDES permit is issued. The new NPDES permit will be issued to assure that stream standards are not violated. The RFP, EPA and CDH are expected to negotiate specific permit conditions in 1991.

It is anticipated that the new discharge limits will be at least as strict as current limits. Also, discussions related to the new NPDES permit indicate that wastewater nitrification and denitrification will be required in the future.

## 2.2 STREAM STANDARDS

The STP discharges to stream Segment 5 of the Big Dry Creek Basin. As defined by the CDH's Water Quality Control Division (WQCD), Stream Segment 5 consists of the "Mainstream tributaries, lakes, and reservoirs, from their sources to the outlet of Ponds A-4 and B-5 on Walnut Creek, and Pond C-2 on Woman Creek. All three ponds are located on Rocky Flats Property."

Further, the WQCD has established that the stream standards for Segment 5 have two qualifiers. The first qualifier states "All water quality standards have the temporary modification of ambient quality until February 1, 1993." The second qualifier states "See attached Tables 1 and 2 for additional underlying standards for Segment 5." Tables 1 and 2 are reproduced in this document as Tables 4 and 5 because of their specificity and their impacts on treatment plant effluent requirements.

The significance of Table 4 is that chronic standards for some of the parameters listed are below currently available detection levels. For example, Dioxin has a chronic standard of 0.000000013 ug/l while the current detection level is 0.01 ug/l. This means that the STP cannot meet stream standards under any condition because the stream standards are below current detection limits.

## Table 4

## STREAM SEGMENT 5
## ADDITIONAL ORGANIC CHEMICAL STANDARDS (1)
## (ug/L)

| Parameter | EPA Method | Chronic Standard | Gas Chromatography (GC) Detection Levels |
|---|---|---|---|
| Acrylonitrile | 625 | 0.058 | *15 |
| Aldrin | 508 | 0.000074 | 0.1 |
| Atrazine | 608(2)/507(3) | 3.0 | 1.0 |
| Benzidine | 625 | 0.00012 | *10 |
| Chlordane | 508 | 0.00046 | 0.1 |
| Chloroform | 502.2 | 0.19 | 1.0 |
| Chloroethyl Ether (BIS) | 625 | 0.0000037 | *10 |
| DDT | 508 | 0.000024 | 0.1 |
| Dichlorobenzidine | 625 | 0.01 | *10 |
| Dieldrin | 508 | 0.000071 | 0.1 |
| Dioxin (2,3,7,80TCDD) | 613 | 0.000000013 | 0.01 |
| Halomethanes | 502.2 | 0.19 | 1.0 |
| Heptachlor | 508 | 0.00028 | 0.1 |
| Hexachloroethane | 525 | 1.9 | 1.0 |
| Hexachlorobenzene | 525 | 0.00072 | 1.0 |
| Hexachlorobutzadiene | 525 | 0.45 | 1.0 |
| Hexachlorocyclohexane, Alpha | 505 | 0.0092 | 0.1 |
| Hexachlorocyclohexane, Beta | 505 | 0.0163 | 0.1 |
| Hexachlorocyclonexane, Gamma (Lindane) | 505 | 0.0186 | 0.1 |
| Hexachlorocyclohexane, Technical | 505/608 | 0.0123 | 0.5 |
| Nitrosodibutylamine N | 607 | 0.0064 | 5 |
| Nitrosodiethylamine N | 607 | 0.0008 | 5 |
| Nitrosodimethylamine N | 607 | 0.0014 | 5 |
| Nitrosodiphenylamine N | 607 | 4.9 | 10 |
| Nitrosopyrrolidine N | 625 | 0.016 | 10 |
| PCBs | 508 | 0.000079 | 1.0 |
| Polynuclear Aromatic Hydrocarbons | 610 | 0.0028 | 1.0 |
| Simazine | 608(2)/507(3) | 4.0 | 1.0 |

## Table 4 (Continued)

### STREAM SEGMENT 5
### ADDITIONAL ORGANIC CHEMICAL STANDARDS (1)
### (ug/L)

| Parameter | EPA Method | Chronic Standard | Gas Chromatography (GC) Detection Levels |
|---|---|---|---|
| Tetrachloroethane 1,1,2,2 | 502.2 | 0.17 | 1.0 |
| Tetrachloroethane | 502.2 | 0.8 | 1.0 |
| Trichloroethane 1,1,2 | 502.2 | 0.6 | 1.0 |
| Trichlorophenol 2,4,6 | 502.2 | 1.2 | 1.0 |

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(1) In the absence of specific, numeric standards for non-naturally occurring organics, the narrative standard "no toxics in toxic amounts" (Section 3.1.11(1)(d)) shall be interpreted as zero with enforcement based on the practical quantification levels (PQL's) for those compounds as defined by the Water Quality Control Division or the U.S. Environmental Protection Agency.

(2) Extraction Method

(3) Analytical Method

* Gas Chromatography/Mass Spectrometry Method

**Table 5**

**STREAM SEGMENT**
**SITE SPECIFIC RADIONUCLIDE STANDARDS***
**(in Picocuries/Liter)**

The radionuclides listed below shall be maintained at the lowest practical level and in no case shall they be increased by any cause attributable to municipal, industrial, or agricultural practices to exceed the site specific numeric standards.

A. Ambient based site-specific standards:

| | Segment 2<br>Standley Lake | Segment 3<br>Great Western Reservoir | Segment 4<br>Segment 5<br>Woman Creek | Segment 4<br>Segment 5<br>Walnut Creek |
|---|---|---|---|---|
| Gross Alpha | 6 | 5 | 7 | 11 |
| Gross Beta | 9 | 12 | 5 | 19 |
| Plutonium | .03 | .03 | .05 | .05 |
| Americium | .03 | .03 | .05 | .05 |
| Tritium | 500 | 500 | 500 | 500 |
| Uranium | 3 | 4 | 5 | 10 |

B. Other site-specific standards applicable to segments 2, 3, 4 and 5.

| | | |
|---|---|---|
| Curium | 244 | 60 |
| Neptunium | 237 | 30 |

* Statewide standards also apply for radionuclides not listed above.

The significance of Table 5 is that these specific radionuclide standards will apply to the STP effluent. While most of these parameters are currently being monitored (Rockwell, 1989), a broader spectrum of radionuclide monitoring can be expected in the future.

In summary, if the required standards of Table 4 are enforced, the RFP has no choice but to reuse/recycle zero discharge wastewater effluent. Nevertheless, this study examines the STP discharge assuming a new NPDES permit. The anticipated permit limits are as described in Section 2.1 with an ammonia limit of 1 mg/l as N and nitrate limit of 10 mg/l as N. While anticipated limits do not now indicate biomonitoring (effluent toxicity), such requirements will most probably be prescribed. Biomonitoring is a bioassay procedure utilizing plant effluent and test animals such as fathead minnows and water fleas, to determine effluent toxicity.

# 3.0 CURRENT CONDITIONS

## 3.1 GENERAL DESCRIPTION

The Rocky Flats Plant is divided into a plutonium processing zone which is a personnel security zone (PSZ) and the non personnel security zone (non PSZ). The STP treats sanitary wastewaters from both zones. Sanitary wastewaters consist of toilets, showers, cooling tower and air washer blowdown, and kitchen wastes from cafeterias located on plant property.

The sanitary sewage collection system is divided into two zones corresponding to the PSZ and non PSZ. Both collection systems converge at Building 990 which is a flow equalization facility consisting of a north and south basin, as shown on Figure 1. The 60,000 gallon capacity north basin is used for flow equalization while the south basin can be used only as an overflow. The STP operators set the flow control valve on the outlet of the north basin to a constant flow of about 250,000 gpd on weekdays and 100,000 gpd on weekends.

Equalized flow leaves Building 990 and flows by gravity to the STP at Building 995. Building 995 is located east of Building 990, outside the PSZ, in the South Walnut Creek drainage just inside the fenced area of RFP. Portions of the STP site lie in a preliminarily assessed Solid Waste Management Unit (SWMU).

An August 9, 1990, compilation of EG&G employees indicated current weekday employment to be about 6,200 people (Rose, 1990). On weekends it is estimated that about 100 people are on site. Three shifts are operational, but almost all employees work a normal day shift.

## 3.2 WASTEWATER CHARACTERIZATION

Very little historical, influent wastewater quality data has been collected on wastewater influent at the STP. This is due in part to the lack of an influent flow meter. All flows are measured at the effluent V-notch weir. Only influent COD, TOC, pH and Gross alpha is routinely collected (Rockwell, 1990). Attempts to correlate COD with $BOD_5$ have been made by Michael Richard, Ph.D., but consistent and reliable results have not been obtained (See Section 3.4).

### 3.2.1 Wastewater Quantity

Historically, effluent flow measured at the STP has been approximately 250,000 gpd during the week and 100,000 gpd over the weekend. Flow data for January through August 1990 are included in Appendix A. Flow data were measured by plant operators at the effluent V-notch weir. The operators record a totalizer reading each day at the same time and subtract it from the preceding day's total. Prior to June 16, 1990, all readings were recorded at 8:00 a.m., documenting the flows from 8:00 a.m. the previous morning to 8:00 a.m. the day they are recorded. As a result of this study, starting June 16, 1990 the flows were recorded at midnight for each subsequent 24 hour period.

For the period January 1, 1990 through August 31, 1990 the wastewater flow averaged 194,000 gpd. The minimum flow of 38,000 gpd occurred on February 25, which was a Sunday. The maximum flow of 382,000 gpd occurred on March 22 and March 23, a Thursday and Friday. During this same period, the Monday through Friday weekday flow averaged 220,000 gpd and the weekend flows 131,000 gpd. Several spikes in the flow recorded in excess of 300,000 gpd occurred as shown in Table 6. These spikes may be due to storm events (infiltration/inflow), normal peak to average flow conditions at RFP, events at the Building 990 equalization facilities or a combination of these items.

**Table 6**

**STP Flows Over 300,000 gpd**

| Date | Day | Flow |
|---|---|---|
| 20-Mar-90 | Tue | 352,000 |
| 22-Mar-90 | Thu | 382,000 |
| 23-Mar-90 | Fri | 382,000 |
| 28-Mar-90 | Wed | 340,000 |
| 29-Mar-90 | Thu | 306,000 |
| 05-Apr-90 | Thu | 318,000 |
| 06-Apr-90 | Fri | 372,000 |
| 10-Apr-90 | Tue | 306,000 |
| 06-Jun-90 | Wed | 306,000 |
| 27-Jul-90 | Fri | 306,000 |

Based on approximately 6,200 workers and the flow records in Appendix, each worker contributes an average hydraulic load of 35.4 gallons per capita per day (gpcd) during their time spent at the RFP. By comparison, the average 24-hour contribution from typical residential, commercial, institutional, and industrial sources is 65 to 80 gpcd (EPA, 1978).

Industrial process production was shutdown in 1989 so none of the 1990 data collection results include the impact (if any) that could be attributed to production operations. Influent to the STP would be expected to be 250,000 gpd during the week and 100,000 gpd during the weekend if production was taking place.

Because production wastewater collection, transport and treatment facilities are separated, no significant loading increase to the STP should accompany resumption of production.

### 3.2.2 Wastewater Quality

Due to the lack of historical influent wastewater quality data, a supplemental sampling program was conducted as a result of this study. Sample collection began July 24, 1990. This sampling program targeted parameters related to a performance evaluation of the STP and for future design purposes. An ISCO model 2700R sequential wastewater sampler was installed at the STP headworks as a result of a project being conducted by EG&G's Clean Water Act Division (CWAD) to collect influent wastewater samples. The sampler collected composite samples based on plant effluent flow. Between each sample the sample line collection was purged with air. Samples were collected at 8:00 a.m.. The sample collected on Wednesday, July 25, 1990 was for the period starting at 8:00 a.m. on Tuesday, July 24 and running to 8:00 a.m. July 25. Thus, the sample was reported as being representative of Tuesday, July 24. Laboratory results for the composite samples are summarized in Table 7 for $BOD_5$, ammonia, total kjeldahl nitrogen (TKN), alkalinity, temperature, and pH.

**Table 7**
**STP Influent Composite Sampling**
**July 25, 1990 to August 24, 1990**

| Sample Date | Day | $BOD_5$ (mg/L) | Ammonia as N (mg/L) | TKN (mg/L) | Alkalinity Grab as CaCO3 (mg/L) | Temp Grab C | pH Composite |
|---|---|---|---|---|---|---|---|
| 24-Jul-90 | Tue | 94 | 35 | 32 | 163.6 | 22.0 | 8.0 |
| 25-Jul-90 | Wed | 100 | 40 | 45 | 170.4 | 24.0 | 7.9 |
| 26-Jul-90 | Thu | 59 | 36 | 43 | 138.4 | 24.0 | 7.7 |
| 27-Jul-90 | Fri | NSC | NSC | NSC | 118.6 | 22.5 | NSC |
| 28-Jul-90 | Sat | 19 | 6 | 12 | 97.4 | 20.0 | 7.3 |
| 29-Jul-90 | Sun | 30 | 6 | 29 | 122.8 | 20.0 | 7.0 |
| 30-Jul-90 | Mon | 160 | 65 | 61 | 121.2 | 20.6 | 8.2 |
| 31-Jul-90 | Tue | 110 | 32 | 48 | 131.8 | 21.5 | 7.7 |
| 01-Aug-90 | Wed | 110 | 41 | 40 | 110.0 | 20.8 | 7.7 |
| 02-Aug-90 | Thu | 100 | 32 | 30 | 106.6 | 20.8 | 7.7 |
| 03-Aug-90 | Fri | 87 | 18 | 18 | 106.0 | 20.3 | 7.4 |
| 04-Aug-90 | Sat | 21 | 5 | 4 | 92.8 | 18.7 | 7.7 |
| 05-Aug-90 | Sun | 20 | 5 | 3 | 130.6 | 18.9 | 7.8 |
| 06-Aug-90 | Mon | 86 | 21 | 34 | 136.2 | 19.8 | 7.8 |
| 07-Aug-90 | Tue | 170 | 16 | 16 | 118.8 | 19.6 | 7.9 |
| 08-Aug-90 | Wed | 130 | 21 | 40 | 112.6 | 20.7 | 7.7 |
| 09-Aug-90 | Thu | 80 | 20 | 49 | 127.0 | 22.8 | 7.4 |
| 10-Aug-90 | Fri | 30 | 16 | 25 | 107.0 | 21.0 | 7.7 |
| 11-Aug-90 | Sat | 40 | 6 | 14 | 85.4 | 19.7 | 7.0 |
| 12-Aug-90 | Sun | 33 | 5 | 11 | 130.8 | 20.2 | 7.4 |
| 13-Aug-90 | Mon | 89 | 21 | 30 | 102.8 | 20.0 | 7.6 |
| 14-Aug-90 | Tue | 100 | 20 | 23 | 115.4 | 22 | 8 |
| 15-Aug-90 | Wed | 56 | 21 | 29 | 119.8 | 22 | 8 |
| 16-Aug-90 | Thu | 56 | 20 | 34 | 120.0 | 23 | 8 |
| 17-Aug-90 | Fri | 43 | 12 | 19 | 96.8 | 21 | 7 |
| 18-Aug-90 | Sat | 49 | 5 | 10 | 80.4 | 20 | 7 |
| 19-Aug-90 | Sun | 24 | 5 | 10 | 110.8 | 20 | 7 |
| 20-Aug-90 | Mon | 180 | 24 | 28 | NSC | NSC | NSC |
| 21-Aug-90 | Tue | 110 | 20 | 23 | NSC | NSC | NSC |
| 22-Aug-90 | Wed | 89 | NSC | 24 | NSC | NSC | NSC |
| 23-Aug-90 | Thu | >180 | NSC | NSC | NSC | NSC | NSC |
| | Avg | 82.50 | 20.50 | 27.03 | 117.56 | 21.0 | 7.61 |
| | Max | >180 | 65 | 61 | 170 | 24 | 8 |
| | Min | 19 | 5 | 3 | 80 | 19 | 7 |

$BOD_5$ Reporting limit: 2 mg/L
TKN Reporting limit: 1 mg/L
NH4 as N Reporting limit: 0.5 mg/L
24-Aug-90 $BOD_5$ was reported as greater than 180 mg/l
NSC Denotes No Samples Collected

The ammonia nitrogen/TKN ratio based on the data presented in Table 7 is 0.75. This ratio indicates that 75 percent of the nitrogen is in the ammonia form. During the weekday, ammonia concentrations exceed what would normally be expected in domestic wastewater. Daily ammonia concentrations as high as 65 mg/l were found in the wastewater which is high relative to domestic wastewater which is usually found to be in concentrations between 25 mg/l and 30 mg/l for medium strength domestic wastewater.

Figure 2 shows the sample results for $BOD_5$ and ammonia. As shown, STP influent water quality varied substantially from weekend to week day. The STP facility must be capable of addressing these wide loading variances during normal operations.

The actual mass load (pounds/day of any particular contaminant) that must be treated at the STP is a function of the $BOD_5$ concentration and flow product i.e., flow multiplied by concentration. Figure 3 shows loads arriving at the STP during the sampling period. The lowest loads occurred on weekends when the workforce was small. Over weekends the average $BOD_5$ and ammonia load was 46.2 pounds per day and 8.54 pounds per day, respectively. During the week the average $BOD_5$ and ammonia load was 205.4 pounds per day and 53.9 pounds per day, respectively. The maximum $BOD_5$ load of 373.63 lbs/d occurred on Thursday, August 23. On this date, the $BOD_5$ was reported as greater than 180 mg/l. An assumed value of 200 mg/l was used to calculate the load. The maximum ammonia load of 119.26 lbs/d occurred on a Monday.

Weekday loads were about 130 percent of the average load while weekend loads were about 25 percent of the average load. The ratio of average weekday to average weekend day loads was 4.4:1 for $BOD_5$ and 6.3:1 for ammonia.

In addition to the composite sampling mentioned above, 24 one-hour discrete samples were collected on August 29, 1990. Results of this sampling are contained in Appendix B and plotted on Figure 4 for $BOD_5$, ammonia, and TKN. Figure 4 depicts the diurnal variation in plant loading. The plateau in the $BOD_5$ at 200 mg/l, for the period from 1400 hours August 29 to

2300 hours August 30, is the result of the laboratory results being reported as >180 mg/l. It is important to note that the TKN, $BOD_5$ and ammonia loads varied considerably even though the flow was being equalized upstream at Building 990. Concentrations of $BOD_5$ peaked at 250 mg/l in the early afternoon after lunch (1200 to 1300 hours). The ratio of peak load to average load over the diurnal cycle was 2.2 for TKN and 1.9 for ammonia. As "a rule of thumb" this represents a minimum safety factor to prevent ammonia bleed through at peak loads (EPA, 1975).

Metals data collected during the 24 hour composite samples are also included in Appendix B. All metals concentrations are below 1 mg/l in the STP influent with the exception of aluminum, iron and magnesium; however, these metals are not expected to be toxic to a biological wastewater treatment system. Metals known to be toxic to biological systems include zinc, copper, mercury, chromium, nickel and silver. Relevant literature suggests that 10 to 20 mg/l of heavy metals can be tolerated at pH values of 7.5 to 8.0 (EPA, 1975). Since December 19, 1988, the only recorded toxic event recorded at the STP was on February 23, 1989. On that date, a chromium spill occurred causing significant loss of the activated sludge biomass (Richard, 1989).

Silver has been found to be extremely toxic to nitrification of secondary effluent utilizing fixed film plastic media (EPA, 1975). Silver was detected in the STP influent in concentrations ranging from undetectable to .012 mg/l. The metals concentrations detected should serve as a precaution against considering fixed film nitrification systems. An indirect method of evaluating wastewater quality is to evaluate waste sludge quality. This technique is especially useful when evaluating metals because they tend to concentrate in waste sludge. High concentrations of silver were found in the drying beds (ASI, 1990e). The reported maximum silver concentration in the sludge was 38,700 parts per billion (ppb), indicating that silver has been a persistent compound in the wastewater treated at the STP. Other sludge metal concentrations are also presented in Table 8.

**Table 8**

**Summary of Maximum Values of Inorganics Detected in Sewage Sludge**

| Constituent | Concentration (ppb) |
|---|---|
| Aluminum | 49,300 |
| Antimony | 15.4 |
| Arsenic | 25.7 |
| Barium | 890 |
| Beryllium | 2.9 |
| Cadmium | 128 |
| Calcium | 215,600 |
| Chromium | 380 |
| Copper | 1,110 |
| Iron | 25,530 |
| Lead | 239 |
| Magnesium | 3,190 |
| Manganese | 278 |
| Mercury | 9.8 |
| Nickel | 75 |
| Potassium | 50,800 |
| Selenium | 4.8 |
| Silver | 38,700 |
| Zinc | 3,500 |

Organic compounds aggregated as oil and grease, were also analyzed as a result of the 24 hour composite sampling; results are included in Appendix B. Most organic pollutants are removed.in the activated sludge process by biooxidation, air stripping, or adsorption to the floc micro biological (Eckenfelder, 1989).

## 3.3 EXISTING SANITARY TREATMENT PLANT

The original STP was constructed in 1952 and has undergone numerous expansions and modifications since then. The original STP consisted of a primary clarifier, an "aerated clarifier", a chlorine contact basin, and an anaerobic sludge digester. This is currently referred to as Train 1. It has been estimated by STP personnel that Train 1 was rated at 80,000 gpd.

Over the next 15 years the original plant was expanded through the addition of what is currently referred to as Train 2 i.e., a second primary clarifier, three "aerated clarifiers", a chlorine contact basin, and a second anaerobic sludge digester. The tankage associated with Train 2 is larger than that associated with Train 1.

In the late 1960's and early 1970's a tertiary clarifier and pressure filters were added to the facility. During this same time period the Building 990 flow equalization basins were added to the Sanitary Sewer System. Two of the four "aerated clarifiers" were removed from service in the early 1970's due to corrosion and were then converted to aerobic digesters.

The existing sewage treatment plant is a conventional activated sludge facility consisting of two parallel trains. Currently only Train 2 is being used. Each train consists of a primary clarifier, aeration basin, and final clarifier as shown on Figure 5. A single comminutor grinds solids at the head of the plant. Although there are two parallel trains, all tankage is unequally sized and without proportional flow control. The operators attempt to split the flow manually at the influent splitter box.

After each train alum and polymer are added to the effluent in a chemical mixing chamber. Chemical dosage is about 40mg/l alum and 2mg/l polymer. After the chemicals are added the effluent is conveyed to a tertiary clarifier and is then pumped through pressure filters. Turbidities leaving the pressure filter are about 0.5 Nephelometric Turbidity Units (NTU). The effluent is then chlorinated (chlorine) and dechlorinated (sulfur dioxide) prior to discharge to the receiving stream.

The aeration basins rely on two 7-1/2 horse power (HP) "aerolators" each for oxygen transfer. Although there was at one time a diffused aeration system (including blowers), the diffused air system was inadequate. The diffusers were installed at unequal depths causing air flow distribution problems. Return activated sludge (RAS) is pumped with an air lift pump and measured with a V-notch weir. Waste activated sludge (WAS) is pumped directly out of the aeration basins with a submersible pump. Typical mixed liquor suspended solids levels (MLSS) are about 2000 mg/l.

## 3.4 SANITARY TREATMENT PLANT PERFORMANCE

Plant operating data was obtained from progress reports numbers 1 through 4 prepared under Contract No. ASC 40600WS (Dr. Mike Richard, 1989a, 1989b) for the period December 19, 1988 to February 6, 1990. These reports show that the plant is consistently capable of treating the present carbonaceous $BOD_5$ load. The plant goes in and out of nitrification (conversion of ammonia to nitrate) as the ammonia load cycles from weekend to weekday. Tabulated nitrogen data show a cyclic trend of partial nitrification occurring at the beginning of the week (Monday) and decreasing to minimal nitrification by Friday. This trend indicates that the plant has the microbiological population (nitrifiers) capable of partial nitrification when loads are down near the weekend. Effluent ammonia concentrations ranged between 0 to 30.7 mg/l; nitrate, the product of ammonia conversion, ranged between 0 and 18.1 mg/l. Operation in this mode results in weekend exceedance of the NPDES permit nitrate standard.

The STP operation was recently changed such that only Train 2 is utilized in treating wastewater. As a result, the plant has not been nitrifying and is now meeting its nitrate limit of 10 mg/l. With future effluent limits for ammonia nitrogen, this mode of operation may not be possible; i.e., ammonia limits may be violated.

### 3.4.1 Major Unit Process Evaluation

Major unit processes were evaluated for their capacity to treat current loadings to current NPDES permit limits. Additionally, existing unit processes were evaluated for nitrification capability in the hopes that only denitrification would need to be added. A flow of 250,000 gpd was used in the evaluation. Plant information was also obtained from a questionnaire completed by plant personnel and confirmed by field tour. A copy of the questionnaire and a memo summarizing the plant tour are included in Appendix C.

Items A through F below describe the processes evaluated in this study. All of the following descriptions will assume the flow split as described in item a below.

a. Primary Treatment

Primary treatment consists of screening and a comminutor prior to flow splitting to the two trains. Flow generally passes through the comminutor which does not work. Screening and comminution at the plant are redundant since these functions already take place at Building 990. Flow splitting is critical to proper operation of the plant because the two trains are unequally sized. No accurate measurement capability for flow splitting exists. The operators try to split the flow 70 percent to Train 2 and 30 percent to Train 1.

b. Primary Clarifiers

The purpose of primary clarifiers is to decrease the load on the activated sludge system. In this case it is also used to settle waste activated sludge prior to the pumping of sludge to the anaerobic digesters. Since the RFP waste load has little settleable material, the value of primary clarification is questionable. Primary clarifier #1 has a surface overflow rate of 390 gpd/sq ft and primary clarifier #2 of 486 gpd/sq ft, both well below an accepted value of 800 gpd/sq ft. The weirs do not appear to be overloaded.

c. Activated Sludge/Aeration Basins

The aeration basins have a combined volume of 112,843 gallons. At 250,000 gpd, the resulting hydraulic detention time is 10.8 hours. At current average and peak $BOD_5$ loads this corresponds to volumetric loadings of 14.2 and 24.2 lb/d/1,000 cu ft., respectively. Each basin has two 7-1/2 horsepower mechanical aerators rated at 2.5 lbs $O_2$/ hp-hr under standard conditions i.e., sea level. At the plant elevation of 5,923 ft and a July wastewater temperature of 24°C, each aerator can provide 1.0 lbs $O_2$/ hp-hr or 180 lbs $O_2$/d. The peak oxygen demand that occurred during this same period is calculated as follows:

| | |
|---|---|
| $BOD_5$: 1.4 lb$O_2$/lb $BOD_5$ x 373.6 lb/d = | 523 lb/d |
| (Conversion of organic carbon to carbon dioxide) | |
| $NH_3$: 4.6 lb$O_2$/lb $NH_3$ x 119.3 lb/d = | 549 lb/d |
| (Conversion of ammonia to nitrate) | |
| | 1,072 lb/d |

The total organic carbon load of 523 lb/day exceeded the aeration capacity by about 200 lb/day (523-320=203). No capacity exists for the conversion of ammonia to nitrate under these load conditions. Assuming the 30-70 percent flow split noted earlier the following results:

| | |
|---|---|
| aerator #1 capacity | = 360 lb/d |
| 30% to aeration basin #1 | = -322 lb/d |
| aeration surplus | 38 lb/d |
| aerator #2 capacity | = 360 lb/d |
| 70% to aeration basin #1 | = -750 lb/d |
| aeration deficit | -390 lb/d |

Under a nitrification operating mode, alkalinity or system buffer capacity is reduced. Approximately 7.14 mg of alkalinity as $CaCO_3$ is destroyed for each milligram of nitrogen oxidized, thus depressing alkalinity and, potentially, pH. Because the nitrification process is pH dependent, sufficient alkalinity must be present for proper process operation. During the supplemental sampling period the average alkalinity was 120.36 mg/l as $CaCO_3$. To oxidize the 65 mg/l ammonia nitrogen experienced during this same period, at least 464 mg/l of alkalinity was needed to maintain pH. In confirmation of this discussion, effluent pH values as low as 3.7 have been reported by Michael Richard, Ph.D. (Richard, 1989a, 1989b, 1990a, 1990b) when operation has been directed toward nitrification.

d. Secondary Clarifiers

The purpose of secondary clarifiers is to separate microbiological mass (mixed liquor suspended solids) from the treated wastewater. Another major purpose of the secondary clarifiers is to thicken the sludge before removal from the clarifier. The RFP secondary clarifiers use air lift pumps to return sludge to the aeration basins. Smaller air lift pumps were installed to waste sludge but these are not used because there is no way to measure the flow. Instead, a small submersible pump is lowered into the aeration basins and mixed liquor is pumped to the primary clarifiers where it is settled and then pumped to anaerobic digester #2. The surface overflow rate for secondary clarifier #1 is 132 gpd/sq ft and for secondary clarifier #2 259 gpd/sq ft. Typically, a secondary clarifier operated below 600 gpd/sq ft can be expected to perform well.

e. Disinfection

The chlorine contact tanks are operated in series and provide 27.2 minutes of detention time at 250,000 gpd. Although this is less than the 30 minutes required by the State of Colorado, no evidence was found to indicate that required disinfection levels were not being attained.

f. Sludge Handling

Sludge handling facilities in activated sludge plants are typically ranked by controllability of the sludge wasting process. Control of waste sludge at RFP is attained by a measuring pump run time for a small submersible pump lowered into the aeration basin. The waste sludge is pumped to the primary clarifiers. The primary sludge is then pumped to the digester using a recessed impeller pump. The pump is run until the sludge stream becomes clear. Approximate sludge waste quantities were determined from discussions with plant operators. Waste sludge is pumped to the primary clarifier at an estimated 13,000 gpd at a concentration of 1,000 mg/l (108 lb/d). Primary sludge is pumped to the digesters at an estimated 1,500 gpd at 15,000 mg/l (188 lb/d).

The existing digesters retain the sludge for approximately 60 days at 1,500 gpd (188 lb/d). The existing sand drying beds used for sludge dewatering are sized for 6,500 gallons per week at 3 percent solids (232 lb/d). Approximately 4,000 gallons per week of digester supernatant is returned to the head of the plant. A solids mass balance on the RFP system could not be achieved due to a lack of flow and solids concentration data.

### 3.4.2 Performance-Limiting Factors

During this evaluation a number of treatment plant performance limiting factors were identified:

Process Control Testing (Operation Problem)

Historically, process control testing has not been performed because the STP does not have a lab for use by operators. Lab equipment is currently being purchased and Michael Richard, Ph.D. will be training the operators in process control testing. In addition, an influent metering flume was to be installed to develop accurate influent flow records.

Sludge Handling (Design Problem)

The existing sludge drying beds are inadequate and the anaerobic digesters, although still in service, are not functioning as required. The existing anaerobic digesters should be converted to aerobic digesters for both safety and process considerations. A new belt filter press and dryer will be purchased for installation during the winter of 1991.

At present, there is no way to effectively concentrate and control activated sludge mixed liquor suspended solids (MLSS) due to the clarifier design. Since the secondary clarifiers do not have a waste sludge hopper, sufficient means to concentrate and measure the amount of sludge wasted is not available.

Return Process Streams (Design Problem)

Anaerobic digester supernatant is returned directly to the aeration basins which adversely impacts process performance. When the belt filter press becomes operational, press filtrate will also be returned to the aeration basins. Digester supernatant has an ammonia concentration of about 300 mg/l; with new NPDES permit limits on ammonia, this will restrict plant discharge. The conversion from anaerobic to aerobic digesters noted above would minimize the ammonia problem.

Aeration & pH Control (Design Problem)

Inadequate aeration capacity exists to handle both the organic ($BOD_5$) and ammonia load to the plant. When organic loads are down and the plant nitrifies alkalinity is consumed, causing a lower pH. Additional aeration capacity is required to nitrify consistently and chemical feed facilities are needed to control (raise) pH.

Flow splitting capability at the influent splitter box is inadequate for flows proportional to the capacity of each train. This results in the need to operate two independent plants, with aeration capacity and pH problems specific to each train.

Denitrification (Design Problem)

There are no provisions for denitrification.

# 4.0 FUTURE CONDITIONS

## 4.1 PLANNED STP UPGRADES

Thirteen upgrade projects are currently underway at the STP. These projects are listed below.

1) Influent/Instrumentation - The instrumentation project is currently under construction. The project consists of continuous influent pH, conductivity and hydrocarbon vapor monitoring. Also included in the project is an on-line respirometer for toxicity testing. This project should also include an automated influent sampler and influent flow meter.

2) Effluent Instrumentation - The effluent instrumentation project is in the design phase. This project consists of an effluent flow nozzle, metering and totalizing.

3) Autochlorination/Dechlorination - The autochlorination/dechlorination project is in the design phase. This project consists of automating the existing chlorination system and the installation of a new sulfur dioxide dechlorination system.

4) Influent Storage Tanks - The influent tanks are under design. They are being designed to hold influent waste that might be toxic due to a spill within RFP.

5) Effluent Storage Tanks - The effluent tanks are also under design. They are being designed to store wastewater in the event of a spill.

6) Enclose Pressure Sand Filter Valves - A scope and estimate is being prepared to enclose the sand filter valves. This project will provide shelter over the filters.

7) Sewage Sludge Dewatering - A scope and estimate has also been prepared for a belt filter press to dewater sludge prior to the rotary sludge dryer following dewatering. A 0.7 meter press housed in the existing sludge drying bed area is proposed. The dewatering and drying projects could impact the treatment process. The 0.7 meter belt filter press is proposed to be located in drying bed area No. 4. The press will dewater sludge from the anaerobic digesters. The filtrate will be returned to the aeration basins. The filtrate consists of ammonia laden liquid from the dewatered sludge and wash water (plant effluent).

8) Rotary Sludge Dryer - A scope and estimate has been prepared for a rotary sludge dryer following dewatering. A gas fired dryer is being proposed.

9) Drying Bed Improvements - The drying bed improvement project is currently on hold. The sludge dewatering and rotary sludge dryer projects obviate the need for drying bed improvements.

10) Shelter (Polymer Feed System) - A scope and estimate is being prepared for a shelter to house the polymer feed system.

11) Pond Sampling Ramps - A scope and estimate is being prepared to install sampling ramps in Pond B-3.

12) Nitrification/Denitrification - A scope and estimate has been prepared to construct facilities suitable for nitrification and denitrification of wastewater.

13) Emergency Generator - A scope and estimate is being prepared for an emergency generator. The existing STP has no emergency power source in case of power failure.

## 4.2 POPULATION/WORKFORCE LEVELS

Through meetings with RFP personnel it was agreed that facilities should be planned for a future workforce of 9,000. In addition, the future STP must be designed with sufficient flexibility to reduce its capacity for an estimated a workforce as low as 3,000.

## 4.3 FLOW AND WASTE LOADS

Flow projections are inexact for a number of reasons. Anticipated future flow is based on the workforce projections and water use habits similar to those which currently exist. Another variable is the quantity of infiltration and inflow (I/I). Infiltration and inflow is being evaluated as a result of Task 1 (ASI, 1990d). The workforce and flow data discussed in Section 3.0 form the basis for the following flow projections.

Future flows at 9,000 population:

Weekday

(9,000/6,200) x 250,000 gpd = 362,610 gpd    Use 400,000 gpd

Weekend

(9,000/6,200) x 100,000 gpd = 144,950 gpd    Use 145,000 gpd

Future flows at 3,000 population:

Weekday

(3,000/6,200) x 250,000 gpd = 120,790 gpd    Use 125,000 gpd

Weekend

(3,000/6,200) x 100,000 gpd = 48,320 gpd    Use 48,000 gpd

Waste organic and ammonia loadings have been evaluated based on data collected as part of this study. As described in Section 3.0, loadings to the plant are highly variable. The loads selected for design must account for this variability. Based on the limited data collected, it appears likely that high $BOD_5$ loads will occur simultaneously with high ammonia loads. The maximum temperature recorded was 24°C; minimum wastewater temperature along the front range of Colorado vary from 7°C in Woodland Park (El. 8130 msl) to 10°C in Fort Collins (El. 4880 msl). The load projections/design parameters shown in Table 9 will be used to project future conditions given the assumptions noted above.

## Table 9
## STP Design Parameters

| | |
|---|---|
| **INFLUENT** | |
| Nominal Plant Capacity @ 9,000 pop. | 400,000 gpd |
| Design $BOD_5$ Concentration | 200 mg/l |
| Design $BOD_5$ Load @ 200 mg/l | 667 lbs/d |
| Design Ammonia Concentration as N | 65 mg/l |
| Design Ammonia Load @ 65 mg/l | 217 lbs/d |
| Alkalinity as $CaCO_3$ | 100 mg/l |
| Influent pH | 7.0 |
| Minimum Temperature | 10 °C |
| Maximum Temperature | 24 °C |
| Nominal Plant Capacity @ 3,000 pop. | 125,000 gpd |
| Design $BOD_5$ Concentration | 200 mg/l |
| Design $BOD_5$ Load @ 200 mg/l | 209 lbs/d |
| Design Ammonia Concentration as N | 65 mg/l |
| Design Ammonia Load @ 65 mg/l | 68 lbs/d |
| Alkalinity as $CaCO_3$ | 100 mg/l |
| Influent pH | 7.0 |
| Minimum Temperature | 10 °C |
| Maximum Temperature | 24 °C |

| EFFLUENT | 30-Day Avg. | 7-Day Avg. | Daily Max. |
|---|---|---|---|
| $BOD_5$-mg/l | 10 | -- | 25 |
| TSS-mg/l | 30 | 45 | -- |
| Fecal Coliform-No/100ml | 200 | 400 | -- |
| Nitrates (as N)-mg/l | 10 | 10 | -- |
| Ammonia (as N)-mg/l | 1 | 1 | -- |
| Total Residual Chlorine-mg/l | -- | -- | 0.003 (Not detectable) |
| Total Chromium-mg/l | 0.05 | -- | 0.10 |
| Total Phosphorous (as P)-mg/l | 8 | -- | 12 |
| pH units | Between 6.0 and 9.0 | | |
| Oil and Grease | Shall be less than 10 mg/l | | |

## 5.0 TREATMENT ALTERNATIVES

Wastewater treatment/reuse systems are capable of serving a wide range of objectives including attainment of water quality levels suitable for direct potable municipal reuse. Objectives are sometimes limited to nominal levels of performance in organic and suspended solids removal, but with high degrees of separation of any particular constituent e.g., ammonia-nitrogen reduction for toxicity control and nitrate-nitrogen reduction for public health reasons.

In the context of this study and for purposes of wastewater treatment for pollution control, the entire dry weather flow must be treated and problems of diurnal and seasonal flow/quality variations dealt with. Often, quantity/quality transients associated with infiltration and inflow (stormwater) must be treated. Additionally, the demand for reusable water may be seasonal and not match the wastewater supply, although impoundment/storage may be used to overcome these production/demand disparities.

Flow variations in wastewater systems may strongly influence process selection and subsequent design/construction. Additionally, industrial wastewaters sometimes dominate the wastewater flow, thus requiring additional project-specific process selection criteria.

In summary, the selection of any wastewater "system" depends on wastewater characteristics, desired effluent properties, overall operating reliability, capital, and operations and maintenance costs. Typically, specific physical (P), chemical (C) and biological (B) unit operations/processes (or combinations thereof) are matched with site-specific criteria to arrive at a selected treatment train. Depending on operating reliability requirements, single or parallel treatment trains are prescribed.

Conventional wastewater treatment systems include the following (letter designations are defined above):

- primary treatment (P)
- secondary treatment (B, P, C)
  activated sludge (many variations).
  trickling filters/related fixed media devices w/ or w/o chemicals (B, B/P/C)
- chlorination (C)

Reuse/recycle treatment systems may include the following:

- activated sludge nitrification (B)
- activated sludge denitrification (B)
- fixed film nitrification (B)
- fixed film denitrification (B)
- filtration (P, C)
- chemical addition; alum or lime (with or without ammonia stripping (C))
- carbon (granular or powdered) adsorption (C, P)
- ammonia reduction via breakpoint chlorination (C)
- ozonation (C)
- land application (B, C, P)
- aquaculture; wetlands, plants, combined systems (B, C, P)
- membrane separation (ultrafiltration) (P)
- ion exchange (P, C)
- membrane separation (reverse osmosis) (P)
- membrane separation (electrodialysis) (P, C)
- others or combinations of all of the above.

Ion exchange, electrodialysis and reverse osmosis are often employed in recycle/reuse applications to remove the increment of minerals (salts) added with any particular water use. With any reuse application, continued reuse results in the need to remove salts to a level consistent with the particular water use. Salt blowdown (waste concentrated brine) accompanies this effort.

In addition to the issues of reuse, treatment train criteria and selection, site specific criteria and others, one must expect the reuse effort to be conducted in concert with an aggressive waste source separation/pretreatment program, control of excessive infiltration/inflow and a water conservation program, all in conformance with current water rights law.

Last, it must be remembered that residual solids are generated in any program of wastewater treatment and reuse. Residuals handling and ultimate utilization/disposal are oftentimes the driving force for the type of wastewater liquid stream treatment facility selected. In the case of the RFP this is certainly the case. For example, waste solids minimization eliminates serious consideration of chemical treatment techniques such as lime or alum addition.

## 5.1 INITIAL SCREENING OF ALTERNATIVES

As a result of weekly progress meetings held at the RFP an initial screening of alternatives was performed. As a result of this screening process the decision was made to look at treatment systems appropriate for treatment and discharge to Walnut Creek under an NPDES permit. Furthermore, it was determined that the treatment system selected must be capable of treating the highly variable loads experienced at the STP, be a proven system, be reliable, and that any new construction must not disrupt treatment or service to the RFP.

Upgrading the existing activated sludge biological treatment plant will require additional tankage to treat design loads. At 400,000 gpd and an operating mixed liquor suspended solids (MLSS) of 2500 mg/l at 10°C, about 330,000 gallons of tankage will be required to nitrify 65 mg/l ammonia as N. Under the same conditions at 125,000 gpd about 104,000 gallons of tankage will be required to nitrify. Theoretical steady state ammonia concentration in the effluent NPDES would be 0.3 mg/l. The existing STP has a total aeration tank volume of 112,843 gallons. This tankage is not adequate for the future design condition of 400,000 gpd.

From the treatment alternatives and initial screening process described above, the projected effluent permit standards and RFP historical use of biological treatment, two biological treatment alternatives were selected for further evaluation.

### 5.1.1 Bardenpho Process (Activated Sludge) - **Alternative No. 1**

The Bardenpho process was initially looked at as a process to nitrify, denitrify and remove phosphorous. It is a patented treatment process that has been used successfully for nutrient removal throughout the world. The process is a multi-stage biological process that removes BOD, suspended solids, nitrogen and phosphorous without the use of chemicals. The process consists of a fermentation stage, first anoxic stage, nitrification stage, second anoxic stage, and a rearation stage. The advantage of the Bardenpho process is that it eliminates the use of chemicals. The disadvantage is that it requires considerable space.

### 5.1.2 Upgrading the Existing STP (Activated Sludge/SBR) - **Alternative No. 2**

Another option is to upgrade the existing STP with the addition of activated sludge batch reactors. A sequencing batch reactor (SBR) is a fill and draw activated sludge treatment system. Municipal and industrial wastewaters have been successfully treated in batch reactor systems. The Arapahoe Water and Sanitation District, which serves the south Denver Tech Center, uses batch reactor technology to successfully treat a highly variable waste load. Batch reactors are also used in numerous industrial applications. Typical applications include food processing, high nitrogen munitions wastes, and petrochemical wastes.

Typically the batch reactor is configured with at least two activated sludge basins to a system. Each basin is operated in a five step sequence as follows:

- Fill
- React (aeration)
- Settle (sedimentation and clarification)
- Draw (decant clarified effluent)
- Idle (sludge wasting)

Batch reactors have several advantages inherent to the system which are appropriate to the situation at the RFP. The advantages of batch reactors over conventional systems are detailed in several sources (EPA, 1986), (Montgomery, 1984). The advantages for the RFP are summarized as follows:

- An SBR serves as an equalization basin and therefore can tolerate greater peak flows and shock loads. Several small, existing, continuous flow, activated sludge plants which were not producing good effluent due to excessive load variations have shown significant improvements in performance after conversion to the SBR mode.

- Because effluent discharge is periodic it is possible to hold effluent until discharge requirements are met. Likewise it is possible to hold a toxic condition and then pump it to effluent holding tanks instead of discharging.

- When flow and loads are smaller than design capacity, liquid level sensors can be set at lower levels. In this way you can prevent wasting power by over operation.

- Mixed liquor solids cannot be washed out by hydraulic surges since they are held in a tank and not discharged until ready.

- No return activated sludge pumping is required since the mixed liquor is always in the reactor.

- Settling is improved because it occurs under nearly ideal quiescent conditions resulting in settling of small floc particles which may be washed out in continuous flow systems. Sludge is concentrated before wasting to the digester.

- Filamentous growth is more easily controlled by varying operating strategies.Sludge Volume Index (SVI) values have been reduced from about 600 to 50 in a series of batch reactors. Alternating high and low substrate concentrations achieved in a SBR appears to limit filamentous growth but permit the growth of healthy floc forming organisms.

- The SBR can be operated to achieve nitrification, denitrification and phosphorus removal. Nitrification can be enhanced by increasing the react time while denitrification can be enhanced by increasing the settle or draw time.

- A continuous plug flow activated sludge reactor such as the Bardenpho achieve high/low substrate conditions in space rather than time as in a SBR. However, the continuous flow reactor cannot easily change the duration of these substrate conditions as in a SBR.

- Observed Ribonucleic Acid (RNA) content of the microorganisms in the SBR is three to four times greater than would be expected from a conventional continuous flow system. Because the growth rate of microorganisms is known to depend on the RNA content of the cells, the SBR culture is capable of processing a greater quantity of substrate at a rate greater than is possible in a conventional continuous flow system. This is perhaps one of the reasons why the react period is significantly shorter (1 or 2 hours) in an SBR system compared to that provided in a continuous flow system (6 to 12 hours) and why the SBR takes less space than a continuous flow system.

## 5.2 RECOMMENDED ALTERNATIVE

The recommended alternative is to upgrade the existing STP with the installation of at least two new activated sludge tanks to serve as batch reactors as noted in Section 5.1.2. Within the alternative evaluation system are weighting factors that influence the overall zero-discharge study. These factors were selected by a committee consisting of cognizant DOE and EG&G personnel. The matrix used to evaluate and weigh Alternatives 1 and 2 is given in Table 10. Shaded areas on Table 10 denote areas of concern. General descriptive comments pertinent to each factor and score follow the matrix.

# TABLE 10

## EVALUATION MATRIX
## TASK 10

| EVALUATION FACTORS | WEIGHTING FACTOR | ALT 1 BARDENPHO ACTIVATED SLUDGE | | ALT 2 SEQUENCING BATCH REACTOR ACTIVATED SLUDGE | |
|---|---|---|---|---|---|
| | | S | W | S | W |
| CONTROLLED DISCHARGE | 10 | 1 | 10 | 1 | 40 |
| WASTE GENERATION | 7 | 5 | 35 | 5 | 35 |
| RISKS | 8 | 5 | 40 | 5 | 40 |
| COST | 6 | 2 | 12 | 5 | 30 |
| DESIGN AND CONSTRUCTION SCHEDULE | 6 | 3 | 18 | 4 | 24 |
| FLEXIBILITY | 8 | 3 | 24 | 5 | 40 |
| WATER RIGHTS | 5 | 4 | 20 | 4 | 20 |
| AIR EMISSIONS | 10 | 5 | 50 | 5 | 50 |
| WETLANDS/T&E SPECIES | 10 | 5 | 50 | 5 | 50 |
| IHSS (SWMU) | 10 | 3 | 30 | 5 | 50 |
| PUBLIC ACCEPTABILITY | 8 | 4 | 32 | 5 | 40 |
| **TOTALS** | | | 321 | | 389 |
| **RANK** | | | 2 | | 1 |

S = SCORE; W = WEIGHTED SCORE = SCORE x WEIGHTING FACTOR

Controlled Discharge - Each alternative was structured to allow treatment and discharge. Therefore, without reuse/recycle component (zero discharge), controlled discharge will occur and ratings for both equal 1.

Waste Generation - Each alternative relies on lightly loaded activated sludge biological treatment, as at present. Light loadings minimize waste activated sludge production. Biological systems almost always produce less residual solids then physical, chemical, or physical/chemical/biological combinations. Neither alternative represents an advantage.

Risk - Each alternative represents the same relative risk assuming parallel unit process/operation capability for both. The deletion of flotation/filtration unit operation will result in a single clarifier only and subsequent higher risk of untreated effluent discharge. Risk factors considered include public health, uncontrolled discharge, standby power/continuous running power (assumed present for both) and effluent toxicity. Rating advantage - none.

Cost - The upgrading of existing facilities via SBR activated sludge represents the most cost effective solution, as the other alternative utilizes new parallel train components of overall larger size and space requirements. Rating advantage to SBR, 5 to 2.

Design and Construction Schedule - Alternative 2 is proposed for construction on the existing site, with no "off-site" constraints known. Alternative 1 represents an alternative with larger space needs and, perhaps, a totally new site. Rating advantage to alternative 2, 4 to 3.

Flexibility - Alternative 2 implemented as recommended i.e., with flotation/filtration, represents parallel unit operation/process capability in all respects through nitrification/denitrification, effluent filtration and disinfection. Alternative 1 does not include filtration capability. Rating advantage to alternative 2, 5 to 3.

Water Rights - Neither alternative represents an advantage re: water rights. No known water rights issues have been examined however, as part of this specific Task. This results in an equal rating of 4.

Air Emissions - Neither alternative represents a distinction re: air emissions. Short term construction emissions would be equal for each alternative.

Wetland, T&E - No evaluation of these issues was conducted as part of this Task. However, it appears as though neither alternative represents any advantage re: wetlands/threatened and endangered species. The continuous discharge of effluent will effectively create a wetland where, originally, one may not have existed.

IHSS/SWMU - Alternative 1 requires a larger site and may require a totally new site. Alternative 2 is planned for the immediate existing site area. Advantage to alternative 2, 5 to 3.

Public Acceptability - Alternative 2 represents an advantage in terms of effluent quality because of effluent filtration with parallel treatment capability. Alternative 1 does not have this total capability. Assuming this represents higher quality effluent and therefore public acceptability, advantage to Alternative 2, 5 to 4.

The process schematic shown in Figure 6 shows the general relationship of recommended improvements to the existing STP. The features of the process are explained in the following text.

### 5.2.1 Equalization Basins

The existing equalization basins will continue to function with an outlet rate control valve to equalize the flow. The piping between the North and South Basins should be modified so that both Basins can effectively be used.

### 5.2.2 Grinder

The recommended improvements call for the installation of a new grinder (muffin monster) to grind plastics, rags etc. The purpose of the grinder will be to minimize maintenance. Grindings will be conveyed to the activated sludge tankage and removed on a frequency consistent with the plants maintenance management program. An auto-sampler will be installed downstream of the grinder.

### 5.2.3 pH Adjustment and Carbon Feed

The pH and alkalinity will be adjusted with the addition of a sodium bicarbonate feeder. The recommended improvements also include a powdered activated carbon (PAC) feeder to help build biomass and adsorb organic compounds. A supplemental source of carbon (methanol, acetone, or brewery wastes) will be added to manage the reduction of nitrate to nitrogen gas (denitrification).

### 5.2.4 Pump Station

A new pump station will discharge to the activated sludge reactors. The size and configuration of the pump station will depend on the number of activated sludge tanks selected.

### 5.2.5 Activated Sludge

Biological waste treatment, nitrification and denitrification will be done in activated sludge tanks operated in a batch mode. While two tanks could handle the anticipated flows and loads, four tanks would allow better isolation capability if a toxic spill occurs. Effluent will be discharged to either the new flotation/filtration clarifier or the existing final clarifier.

### 5.2.6 Flotation/Filtration

Activated sludge effluent will be further treated with the new flotation/filtration clarifier. Using dissolved air, flocs and suspended solids are floated to the surface. The floating solids are then removed. Material that won't float is removed in the sand filter portion of the unit. This unit combines the functions of the existing final clarifier and pressure filters. This new facility will maintain the parallel train capability in combination with the existing clarifier/filters.

### 5.2.7 Final Clarifier

The existing final clarifier will continue to be used and, in conjunction with the flotation/filtration unit, will maintain the treatment process parallel unit capacity.

### 5.2.8 Pressure Filters

The existing pressure filters will continue to be used.

5.2.9 Chlorination/Dechlorination

The existing chlorine facilities and dechlorination equipment will continue to be used prior to discharge.

5.2.10 Aerobic Digestion

The existing anaerobic digesters will be converted to aerated sludge holding tanks. The covers will be removed and air diffusers installed.

5.2.11 Belt Press & Dryer

The proposed belt press and dryer will continue to be used to dewater and dry sludge to 60 percent solids. The dried solids will be boxed and shipped to a disposal site.

## 6.0 COST EVALUATION OF RECOMMENDED ALTERNATIVE

A preliminary cost estimate for the recommended alternative was described in an ASI report entitled Scope and Estimate for Nitrification/Denitrification, October 9, 1990. The estimated cost summary from that report is presented below.

ESTIMATED COST SUMMARY
PROJECT COST ESTIMATING FORMAT

| | | | | | | |
|---|---|---|---|---|---|---|
| A. | Engineering Design and Inspection (EDI) | | | | | $292,220.00 |
| | EDI Percent of Construction Cost | | | 16% | | |
| | Engineering Title I and II | | | | $ 143,292.00 | |
| | Engineering Title III | | | | 94,138.00 | |
| | Construction Inspection @ 18% | | | | 54,790.00 | |
| B. | Land and Land Rights | | | | 0.00 | |
| C. | Construction Costs | | | | 1,826,370.00 | |
| | (1) | Improvements to Land | | $ 138,800.00 | | |
| | (2) | Buildings | | 1,600,000.00 | | |
| | | (A) | New | 0.00 | | |
| | | (B) | Modifications | 1,600,600.00 | | |
| | (3) | Other Structures | | | 0.00 | |
| | (4) | Special Facilities | | | 0.00 | |
| | (5) | Utilities | | | 0.00 | |
| | (6) | Project Construction Management (PCM) | | | 86,970.00 | |
| | | PCM Percent of Construction Cost | | 5% | | |
| D. | Standard Equipment | | | | | $ 0.00 |
| E. | Removal Cost Less Salvage | | | | | $ 0.00 |
| F. | Contingency @ Approximately 25% of All Other Costs | | | | | $ 529,648.00 |
| G. | Total Estimated Cost (TEC) | | | | | $2,648,238.00 |

## 7.0 GLOSSARY

Absorption: Assimilation of molecules or other substances into the physical structure of a liquid or solid without chemical reaction.

**Activated Sludge:** An aerobic biological process for conversion of soluble organic matter to solid biomass, removable by gravity or filtration.

**Activated Sludge Treatment:** A biological treatment process in which sewage is aerated and agitated with a high concentration of flocculated bacteria and then clarified by sedimentation.

**Adsorption:** Physical adhesion of molecules or colloids to the surfaces of solids without chemical reaction.

**Aeration:** Causing intimate contact between liquid and air to dissolve oxygen in the liquid accomplished by diffusing air bubbles into the liquid.

**Aerobic Organism:** An organism that requires oxygen for its respiration.

**Aerobic Treatment:** A biological treatment process in which bacteria stabilize organic material in the presence of dissolved oxygen.

**Alkalinity:** By definition, total alkalinity (also called M alkalinity) is that which will react with acid as the pH of the sample is reduced to the methyl orange endpoint - about pH 4.2. Another significant expression is P alkalinity, which exists above pH 8.2 and is that which reacts with acid as the pH of the sample is reduced to 8.2.

**Anaerobic Organism:** An organism that thrives in the absence of oxygen.

**Anaerobic Treatment:** A biological treatment process in which bacteria stabilize organic material in the absence of dissolved oxygen.

**Anion:** A negatively charged ion resulting from dissociation of salts, acids, or alkalies in aqueous solution

**Bacteria:** Microscopic single-cell organisms typically identified by their shapes: coccus, spherical; bacillus, rod-shaped; spirillum, curved, etc.

**Biocide:** A chemical used to control the population of troublesome organisms.

**Blowdown:** The withdrawal of water from an evaporating water system to maintain a solids balance within specified limits of concentration of those solids.

**BOD:** Biochemical oxygen demand of a water, being the oxygen required by bacteria for oxidation of the soluble organic matter under controlled test conditions.

**Btu:** British thermal unit

**Buffer**: A substance in solution which accepts hydrogen ions or hydroxyl ions added to the solution as acids or alkalies, minimizing a change in pH.

**C**: Centigrade degrees

**Cake**: A term applied to a dewatered residue from a belt filter press, centrifuge, or other dewatering device.

**Cation**: A positively charged ion resulting from dissociation of molecules in solution.

**Centrate**: The liquid remaining after removal of solids as a cake in a centrifuge.

**cfm**: cubic foot per minute.

**cfs**: cubic foot per second.

**Chlorination**: The application of chlorine, generally to treated sewage, to kill microorganisms that are discharged from the treatment plant with the treated sewage.

**Coagulation**: The neutralization of the charges on colloidal matter (sometimes considered jointly with flocculation).

**COD**: Chemical oxygen demand, a measure of organic matter and other reducing substances in water.

**Coliform Bacteria**: Bacteria found in the intestinal tract of warm-blooded animals and used as indicators of pollution if found in water.

**Concentration**: The process of increasing the dissolved solids per unit volume of solution, usually by evaporation of the liquid; also, the amount of material dissolved in a unit volume of solution.

**Condensate**: Water obtained by evaporation and subsequent condensation.

**Contaminant**: Any foreign component present in another substance; e.g., anything in water that is not $H_2O$ is a contaminant.

**Demineralization**: Any process used to remove (salt) minerals from water.

**Denitrification**: In the absence of dissolved oxygen, bacterial breakdown of nitrates to nitrogen gas and oxygen. The oxygen is used by bacteria and the nitrogen gas is released to the atmosphere.

**Desalination**: The removal of inorganic dissolved solids (salt) from water.

**Desalting**: The removal of salt.

**Dewater**: To separate water from sludge to produce a cake that can be handled as a solid.

**Disinfection**: Application of energy or chemical to kill pathogenic organisms.

**D.O.**: Dissolved oxygen.

**Effluent**: The treated and clarified sewage that flows out of the treatment plant.

**Equalization**: Minimization of variations in flow and mass composition by means of storage.

F: Fahrenheit degrees

**Facultative Organisms**: Microbes capable of adapting to either aerobic or anaerobic environments.

**Filtrate**: The liquid remaining after removal of solids as a cake.

**Filtration**: The process of separating solids from a liquid by means of a porous substance through which only the liquid passes.

**Flocculation**: The process of agglomerating coagulated particles into settleable floc, usually of a gelatinous nature.

**Flotation**: A process of separating solids from water by developing a froth in a vessel in such fashion that the solids attach to air bubbles and float to the surface for collection.

**F/M ratio**: Food-to-mass or food-to-microorganism ratio used to predict the phase of growth being experienced by the major microbial populations in a biological treatment process, such as activated sludge.

**gal**: gallon

**gpcd**: gallons per capita per day

**gpd**: gallon per day

**gpm**: gallon per minute

**hp**: horsepower

**Infiltration**: Leakage of groundwater into sewage piping.

**Influent**: The untreated sewage that flows into the treatment plant.

**kw**: kilowatt

**lb**: pound

**Membrane**: A barrier, usually thin, that permits the passage only of particles up to a certain size or of special nature.

**Metabolize:** To convert food, such as soluble organic matter, to cellular matter and gaseous by-products by a biological process.

**Microorganism:** Organisms (microbes) observable only through a microscope; larger, visible types are called *macroorganisms.*

**mg:** million gallons, also milligram

**mgd:** million gallons per day

**ml:** milliliter

**Milligrams Per Liter (mg/l):** The same as parts per million (6ppm). An expression of the concentration of a specified component in water. A ratio of grams per million grams, pounds per million pounds, etc.

**mg:** microgram

**Mixed Liquor:** The contents of the aeration compartment of an activated sludge treatment plant. A suspension of sewage solids and microorganisms.

**Neutralization:** Most commonly, a chemical reaction that produces a resulting environment that is neither acidic nor alkaline. Also, the addition of a scavenger chemical to an aqueous system in excess concentration to eliminate a corrosive factor, such as dissolved oxygen.

**Nitrification:** A biological process in which certain groups of bacteria, in the presence of dissolved oxygen, convert the excess ammonia ($NH_3$) nitrogen in sewage to the more stable nitrate ($NO_3$) form.

**NPDES permit:** The National Pollution Discharge Elimination System permit required by and issued by EPA.

**Osmosis:** The passage of water through a permeable membrane separating two solutions of different concentrations; the water passes into the more concentrated solution.

**Oxidation:** A chemical reaction in which an element or ion is increased in positive valence, losing electrons to an oxidizing agent.

**Pathogens:** Disease-producing microbes.

**Permeability:** The ability of a body to pass a fluid under pressure.

**pH:** A means of expressing hydrogen ion concentration in terms of the powers of 10; the negative logarithm of the hydrogen ion concentration.

**Pollutant:** A contaminant at a concentration high enough to endanger the aquatic environment or the public health.

**Polymer**: A chain of organic molecules produced by the joining of primary units called *monomers*.

**ppb**: part per billion

**ppm**: part per million

**Precipitate**: An insoluble reaction product; in an aqueous chemical reaction, usually a crystalline compound that grows in size to become settleable.

**Primary Treatment**: A physical process, usually plain sedimentation, used to obtain partial treatment of sewage.

**Reverse Osmosis**: A process that reverses (by the application of pressure) the flow of water in the natural process of osmosis so that it passes from the more concentrated to the more dilute solution.

**SBR**: Sequencing Batch Reactor; one of many variations of the activated sludge wastewater treatment process.

**Scale**: The precipitate that forms on surfaces in contact with water as the result of a physical or chemical change.

**Secondary Treatment**: A biological treatment process designed to achieve a high degree of sewage stabilization generally through the action of aerobic bacteria. e.g. activated sludge.

**Sedimentation**: Gravitational settling of solid particles in a liquid system.

**Sewage**: Waste fluid in a sewer; water supply fouled by various uses through the addition of organic and inorganic material.

**Sludge Volume Index**: An inverse measure of sludge density.

**Softening**: The removal of hardness (calcium and magnesium) from water.

**Stoichiometric**: The ratio of chemical substances reacting in water that corresponds to their combining weights in a theoretical chemical reaction.

**Supernate**: The liquid overlying the sludge layer in a sedimentation /digestion vessel.

**Weir**: A spillover device used to measure or control water flow.

## 8.0 REFERENCES


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## 9.0 ACKNOWLEDGMENTS

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B. Burbridge, EG&G - RCRA/ER
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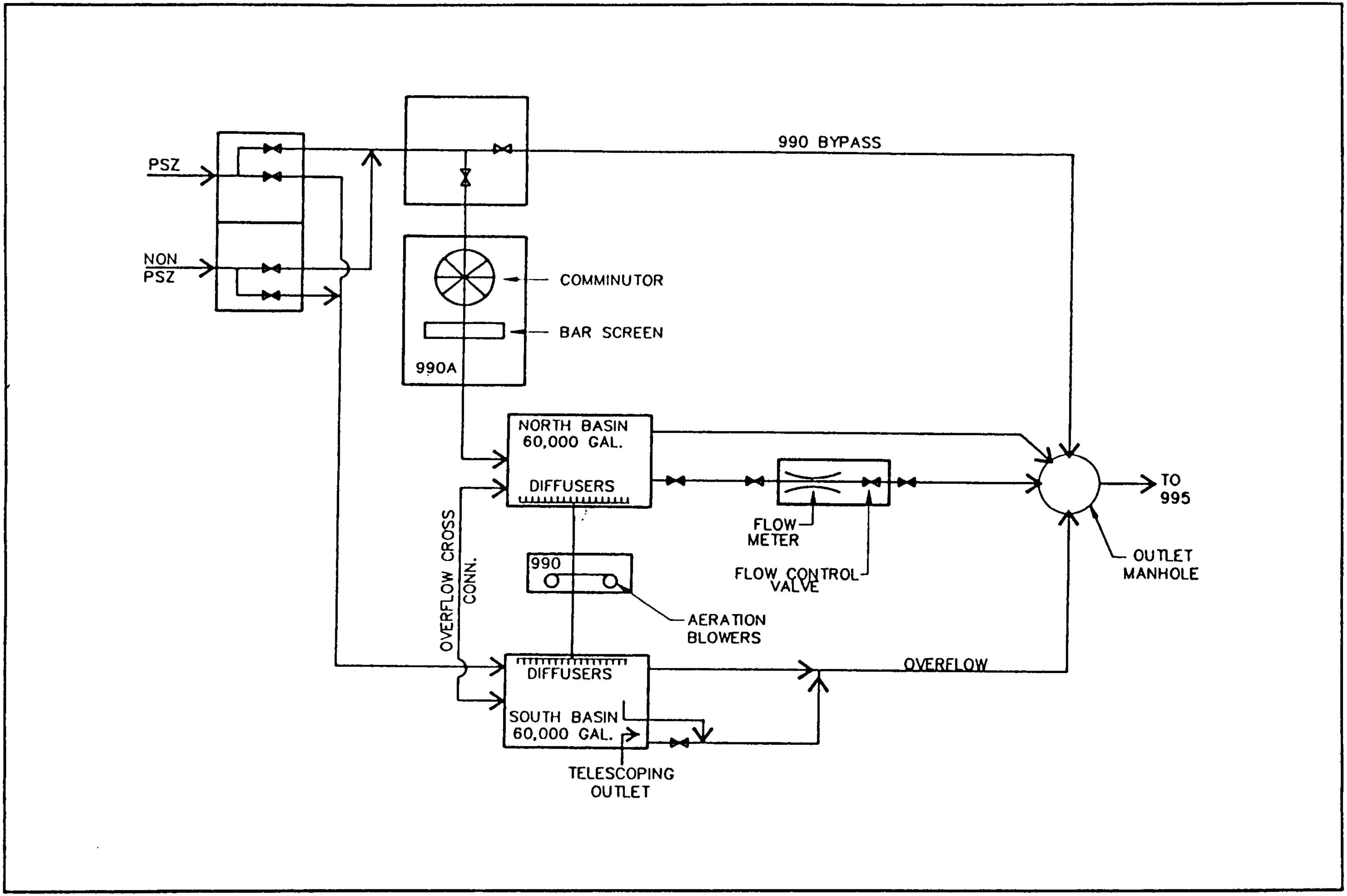
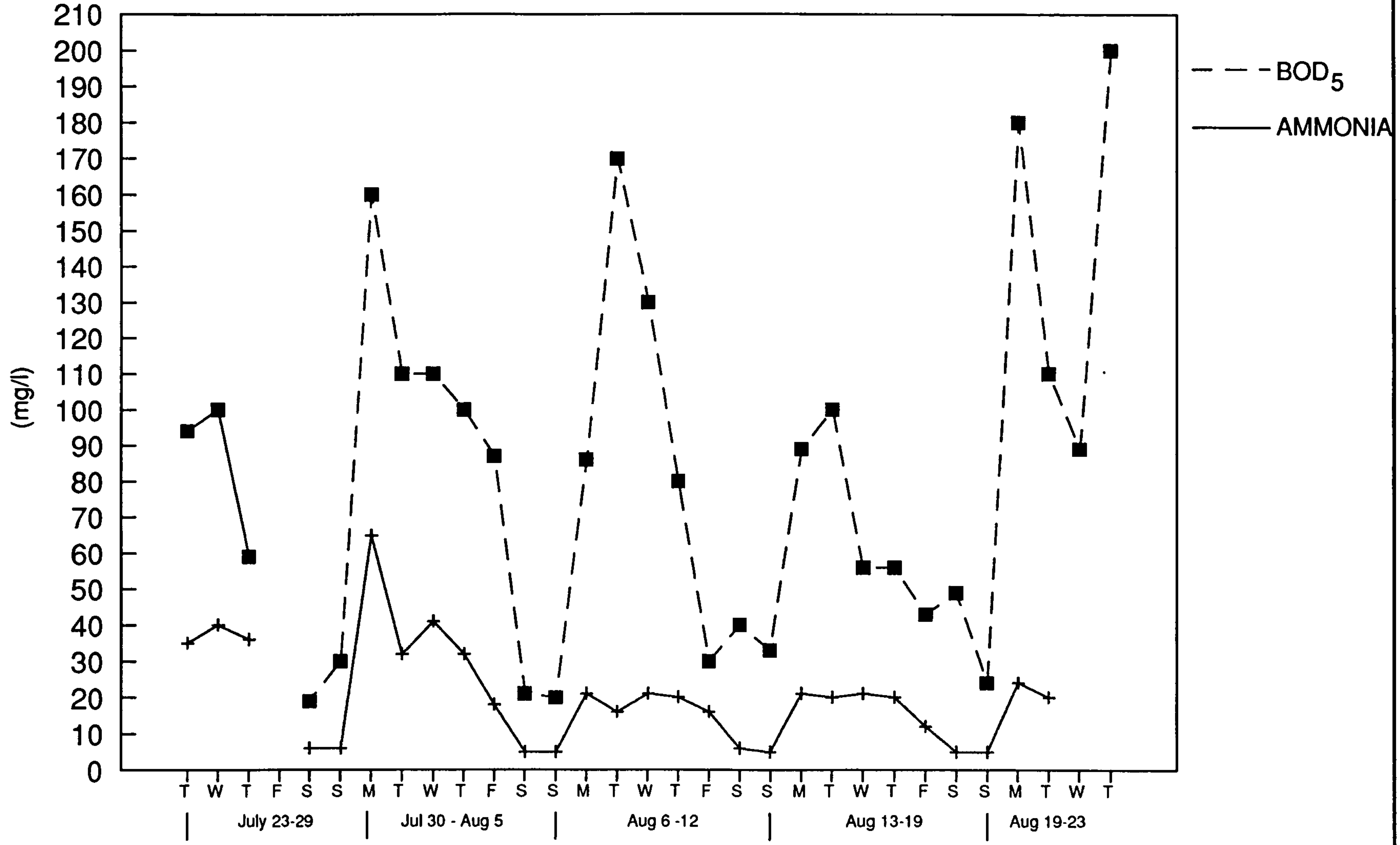
This report was prepared and submitted in partial fulfillment of the Zero-Offsite Water-Discharge Study being conducted by ASI on behalf of EG&G Rocky Flats, Inc. EG&G's Project Engineer for this Study was Mr. R.A. Applehans of EG&G's Facilities Engineering, Plant Civil-Structural Engineering (FE/PCSE).




**BUILDING 990 BASINS**

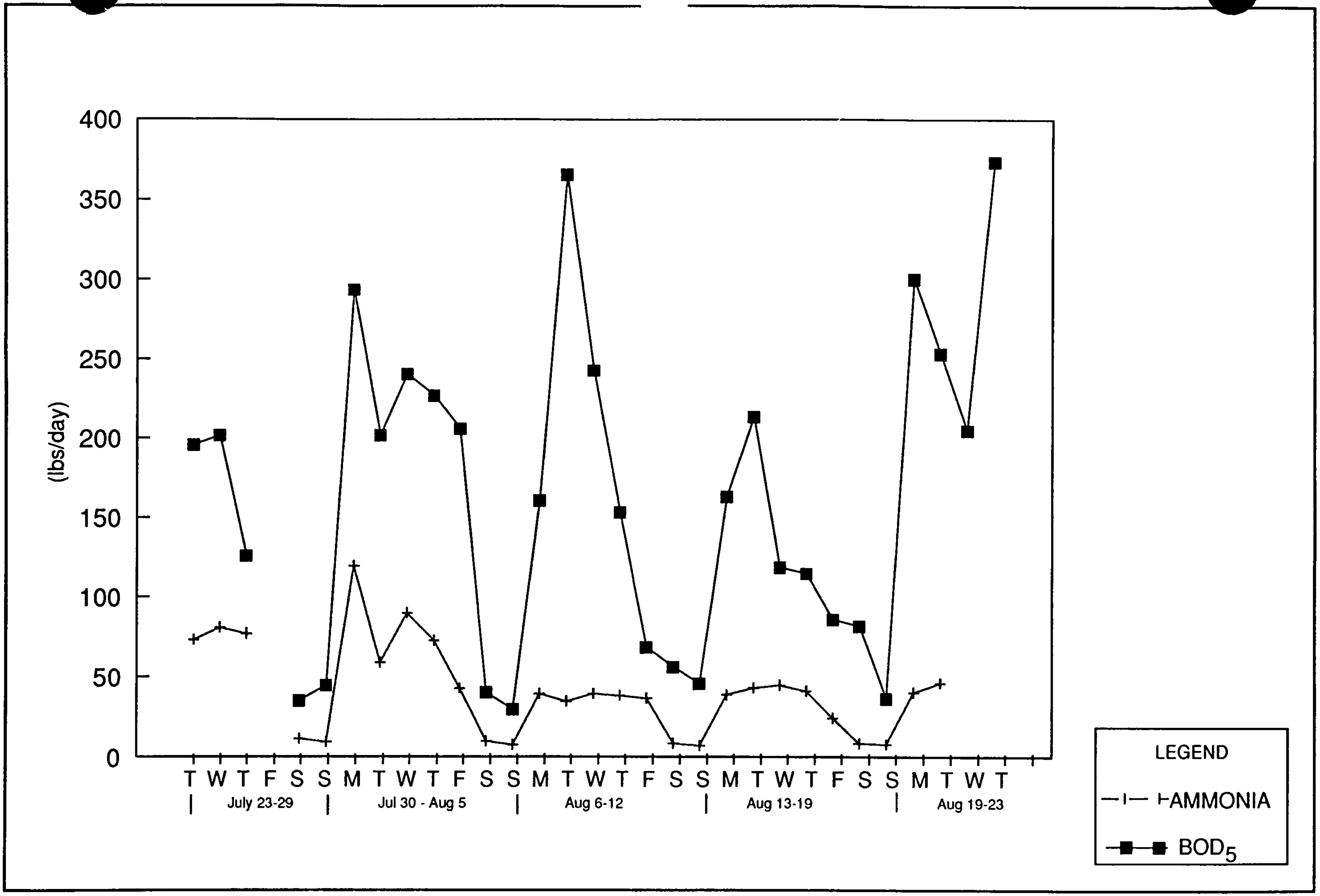



**STP INFLUENT $BOD_5$ AND AMMONIA**

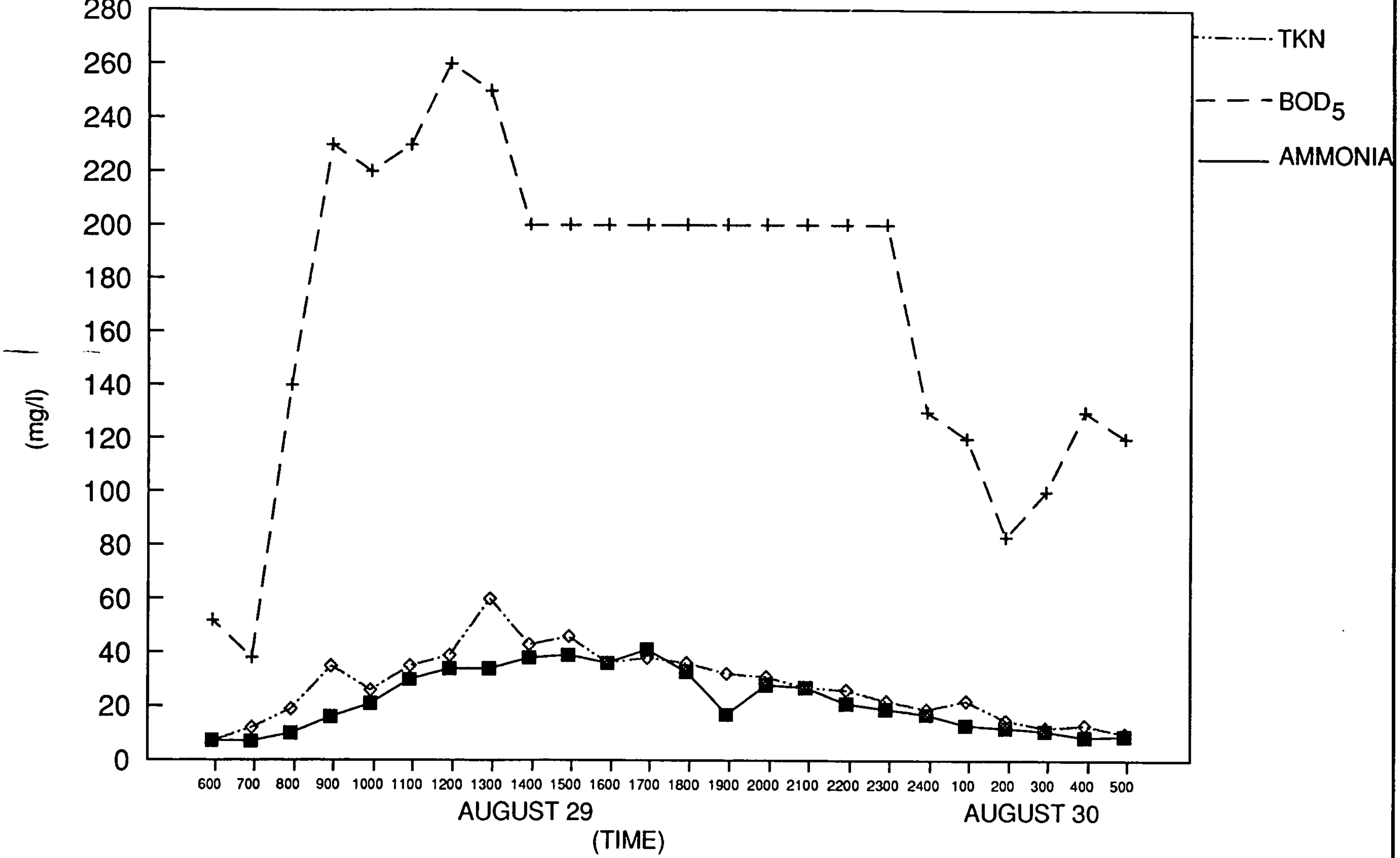
Sanitary Treatment Plant Evaluation
Zero-Offsite Water Discharge

PROJECT 20801.10

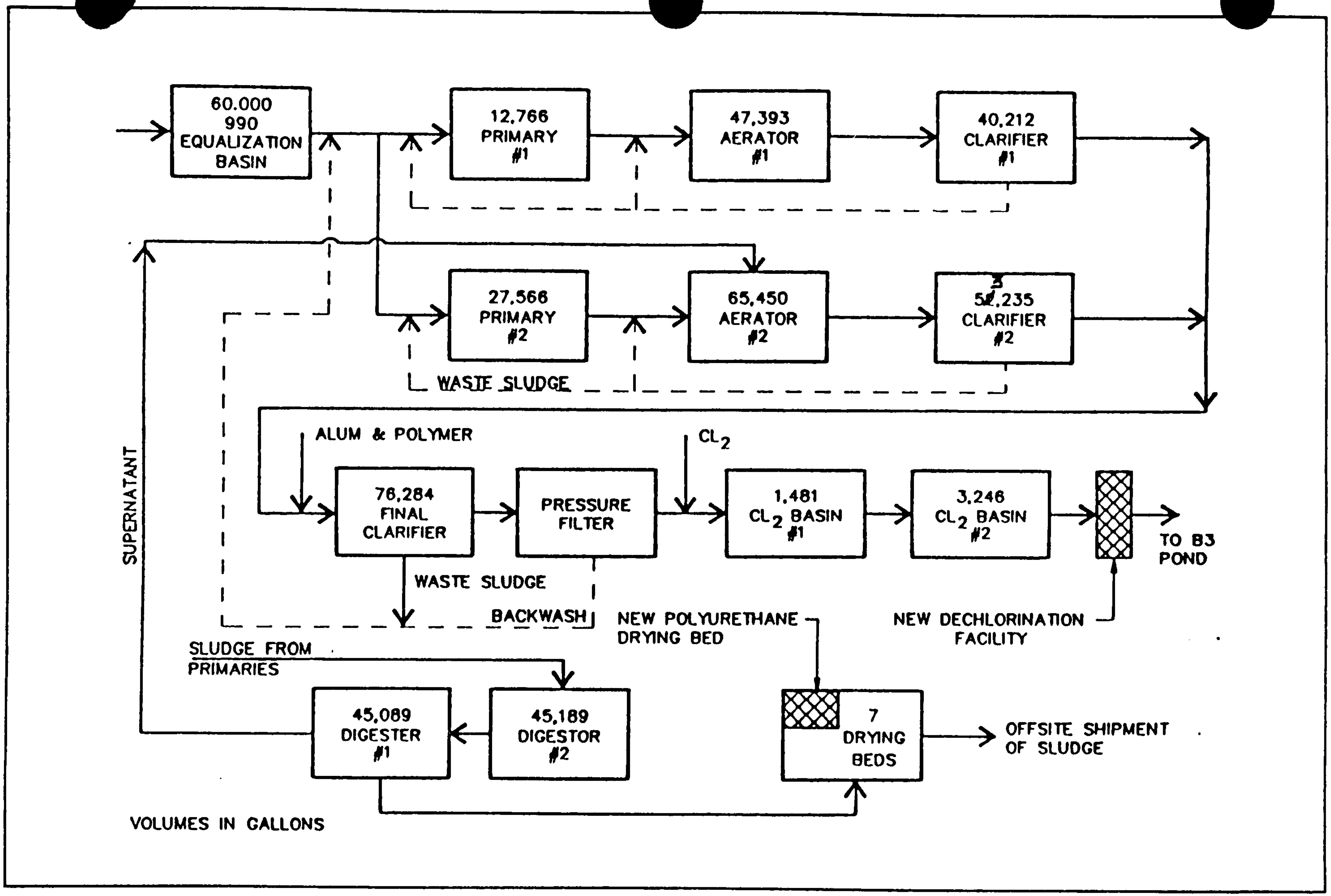
**FIGURE 2**




**STP $BOD_5$ AND AMMONIA LOADS**

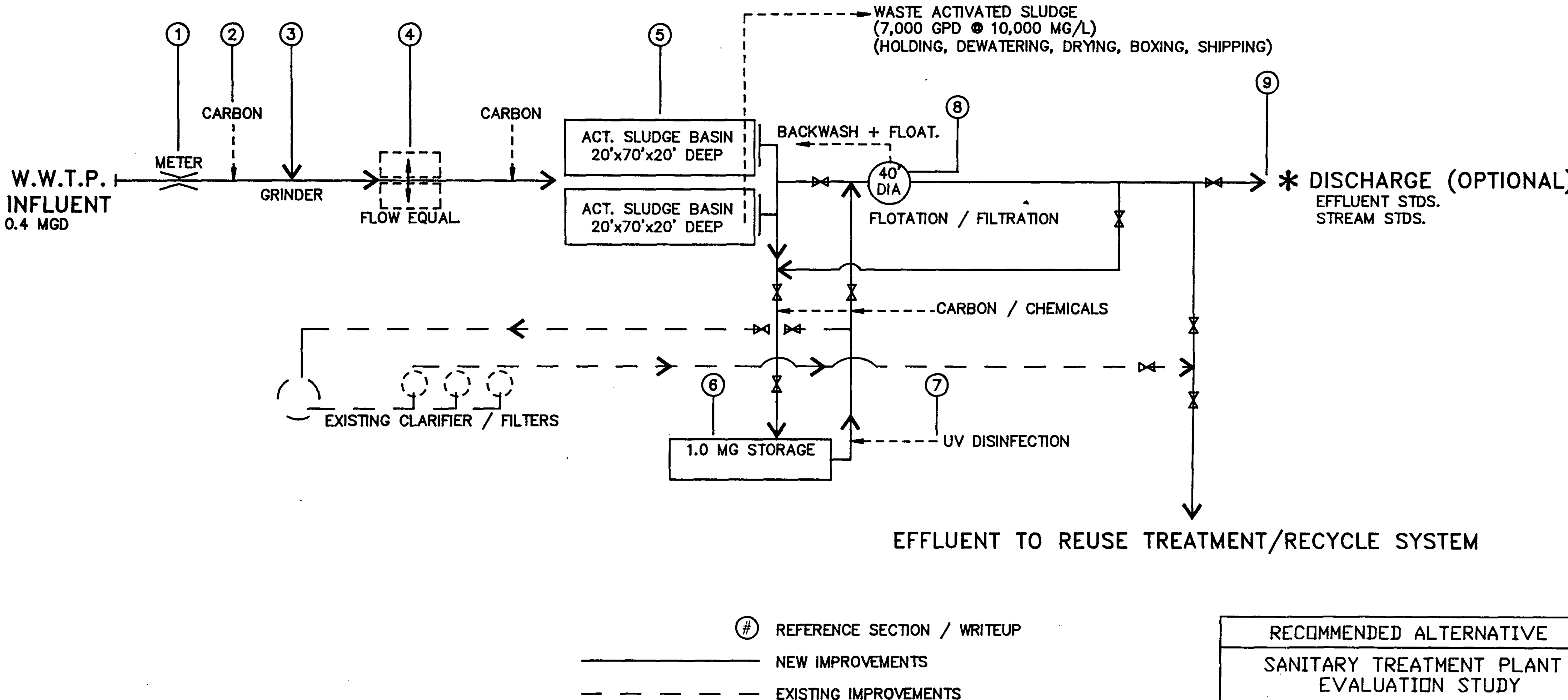



**DIURNAL $BOD_5$ AND AMMONIA**




**ROCKY FLATS PLANT SANITARY PLANT SCHEMATIC**

# CONCEPTUAL LIQUID / SOLID SCHEMATIC




| |
|---|
| RECOMMENDED ALTERNATIVE |
| SANITARY TREATMENT PLANT EVALUATION STUDY |
| ZERO OFFSITE WATER DISCHARGE STUDY |
| PROJECT: 208.0110 — DATE: DECEMBER 1990 — FIGURE 6 |

F
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# APPENDIX A

# SANITARY TREATMENT PLANT

# FLOW DATA

| Date | Day | Flow (mgd) | Avg M-F Flow (mgd) | Avg S-S Flow (mgd) |
|---|---|---|---|---|
| | | 0.064 | | |
| 01-Jan-90 | M | 0.054 | | |
| 02-Jan-90 | T | 0.158 | | |
| 03-Jan-90 | W | 0.158 | | |
| 04-Jan-90 | T | 0.198 | | |
| 05-Jan-90 | F | 0.208 | 0.1552 | |
| 06-Jan-90 | S | 0.082 | | |
| 07-Jan-90 | S | 0.074 | | 0.078 |
| 08-Jan-90 | M | 0.168 | | |
| 09-Jan-90 | T | 0.158 | | |
| 10-Jan-90 | W | 0.238 | | |
| 11-Jan-90 | T | 0.200 | | |
| 12-Jan-90 | F | 0.194 | 0.1916 | |
| 13-Jan-90 | S | 0.090 | | |
| 14-Jan-90 | S | 0.076 | | 0.083 |
| 15-Jan-90 | M | 0.164 | | |
| 16-Jan-90 | T | 0.218 | | |
| 17-Jan-90 | W | 0.148 | | |
| 18-Jan-90 | T | 0.118 | | |
| 19-Jan-90 | F | 0.176 | 0.1648 | |
| 20-Jan-90 | S | 0.096 | | |
| 21-Jan-90 | S | 0.080 | | 0.088 |
| 22-Jan-90 | M | 0.270 | | |
| 23-Jan-90 | T | 0.190 | | |
| 24-Jan-90 | W | 0.188 | | |
| 25-Jan-90 | T | 0.202 | | |
| 26-Jan-90 | F | 0.188 | 0.2076 | |
| 27-Jan-90 | S | 0.092 | | |
| 28-Jan-90 | S | 0.064 | | 0.078 |
| 29-Jan-90 | M | 0.220 | | |
| 30-Jan-90 | T | 0.190 | | |
| 31-Jan-90 | W | 0.196 | | |
| 01-Feb-90 | T | 0.196 | | |
| 02-Feb-90 | F | 0.172 | 0.1948 | |
| 03-Feb-90 | S | 0.092 | | |
| 04-Feb-90 | S | 0.068 | | 0.08 |
| 05-Feb-90 | M | 0.100 | | |
| 06-Feb-90 | T | 0.162 | | |
| 07-Feb-90 | W | 0.204 | | |
| 08-Feb-90 | T | 0.204 | | |
| 09-Feb-90 | F | 0.166 | 0.1672 | |
| 10-Feb-90 | S | 0.094 | | |
| 11-Feb-90 | S | 0.066 | | 0.08 |
| 12-Feb-90 | M | 0.156 | | |
| 13-Feb-90 | T | 0.174 | | |
| 14-Feb-90 | W | 0.214 | | |
| 15-Feb-90 | T | 0.196 | | |
| 16-Feb-90 | F | 0.104 | 0.1688 | |
| 17-Feb-90 | S | | | |
| 18-Feb-90 | S | 0.038 | | 0.038 |
| 19-Feb-90 | M | 0.254 | | |
| 20-Feb-90 | T | 0.240 | | |

| Date | Day | Flow (mgd) | Avg M-F Flow (mgd) | Avg S-S Flow (mgd) |
|---|---|---|---|---|
| 21-Feb-90 | W | 0.116 | | |
| 22-Feb-90 | T | 0.206 | | |
| 23-Feb-90 | F | 0.206 | 0.2044 | |
| 24-Feb-90 | S | 0.038 | | |
| 25-Feb-90 | S | 0.078 | | 0.058 |
| 26-Feb-90 | M | 0.052 | | |
| 27-Feb-90 | T | 0.132 | | |
| 28-Feb-90 | W | 0.192 | | |
| 01-Mar-90 | T | 0.168 | | |
| 02-Mar-90 | F | 0.196 | 0.148 | |
| 03-Mar-90 | S | 0.068 | | |
| 04-Mar-90 | S | 0.080 | | 0.074 |
| 05-Mar-90 | M | 0.074 | | |
| 06-Mar-90 | T | 0.174 | | |
| 07-Mar-90 | W | 0.154 | | |
| 08-Mar-90 | T | 0.126 | | |
| 09-Mar-90 | F | 0.142 | 0.134 | |
| 10-Mar-90 | S | 0.138 | | |
| 11-Mar-90 | S | 0.084 | | 0.111 |
| 12-Mar-90 | M | 0.080 | | |
| 13-Mar-90 | T | 0.136 | | |
| 14-Mar-90 | W | 0.138 | | |
| 15-Mar-90 | T | 0.146 | | |
| 16-Mar-90 | F | 0.262 | 0.1524 | |
| 17-Mar-90 | S | 0.196 | | |
| 18-Mar-90 | S | 0.062 | | 0.129 |
| 19-Mar-90 | M | 0.172 | | |
| 20-Mar-90 | T | 0.352 | | |
| 21-Mar-90 | W | 0.198 | | |
| 22-Mar-90 | T | 0.382 | | |
| 23-Mar-90 | F | 0.382 | 0.2972 | |
| 24-Mar-90 | S | 0.192 | | |
| 25-Mar-90 | S | 0.162 | | 0.177 |
| 26-Mar-90 | M | 0.278 | | |
| 27-Mar-90 | T | 0.264 | | |
| 28-Mar-90 | W | 0.340 | | |
| 29-Mar-90 | T | 0.306 | | |
| 30-Mar-90 | F | 0.204 | 0.2784 | |
| 31-Mar-90 | S | 0.142 | | |
| 01-Apr-90 | S | 0.108 | | 0.125 |
| 02-Apr-90 | M | 0.268 | | |
| 03-Apr-90 | T | 0.280 | | |
| 04-Apr-90 | W | 0.238 | | |
| 05-Apr-90 | T | 0.318 | | |
| 06-Apr-90 | F | 0.372 | 0.2952 | |
| 07-Apr-90 | S | 0.246 | | |
| 08-Apr-90 | S | 0.174 | | 0.21 |
| 09-Apr-90 | M | 0.278 | | |
| 10-Apr-90 | T | 0.306 | | |
| 11-Apr-90 | W | 0.292 | | |
| 12-Apr-90 | T | 0.296 | | |
| 13-Apr-90 | F | 0.160 | 0.2664 | |

| Date | Day | Flow (mgd) | Avg M-F Flow (mgd) | Avg S-S Flow (mgd) |
|---|---|---|---|---|
| 14-Apr-90 | S | 0.134 | | |
| 15-Apr-90 | S | 0.124 | | 0.129 |
| 16-Apr-90 | M | 0.222 | | |
| 17-Apr-90 | T | 0.256 | | |
| 18-Apr-90 | W | 0.232 | | |
| 19-Apr-90 | T | 0.228 | | |
| 20-Apr-90 | F | 0.266 | 0.2408 | |
| 21-Apr-90 | S | 0.146 | | |
| 22-Apr-90 | S | 0.110 | | 0.128 |
| 23-Apr-90 | M | 0.238 | | |
| 24-Apr-90 | T | 0.226 | | |
| 25-Apr-90 | W | 0.234 | | |
| 26-Apr-90 | T | 0.284 | | |
| 27-Apr-90 | F | 0.284 | 0.2532 | |
| 28-Apr-90 | S | 0.166 | | |
| 29-Apr-90 | S | 0.130 | | 0.148 |
| 30-Apr-90 | M | 0.222 | | |
| 01-May-90 | T | 0.212 | | |
| 02-May-90 | W | 0.224 | | |
| 03-May-90 | T | 0.224 | | |
| 04-May-90 | F | 0.292 | 0.2348 | |
| 05-May-90 | S | 0.162 | | |
| 06-May-90 | S | 0.120 | | 0.141 |
| 07-May-90 | M | 0.226 | | |
| 08-May-90 | T | 0.214 | | |
| 09-May-90 | W | 0.220 | | |
| 10-May-90 | T | 0.226 | | |
| 11-May-90 | F | 0.248 | 0.2268 | |
| 12-May-90 | S | 0.140 | | |
| 13-May-90 | S | 0.114 | | 0.127 |
| 14-May-90 | M | 0.208 | | |
| 15-May-90 | T | 0.218 | | |
| 16-May-90 | W | 0.268 | | |
| 17-May-90 | T | 0.200 | | |
| 18-May-90 | F | 0.220 | 0.2228 | |
| 19-May-90 | S | 0.136 | | |
| 20-May-90 | S | 0.127 | | 0.1315 |
| 21-May-90 | M | 0.198 | | |
| 22-May-90 | T | 0.164 | | |
| 23-May-90 | W | 0.256 | | |
| 24-May-90 | T | 0.226 | | |
| 25-May-90 | F | 0.212 | 0.2112 | |
| 26-May-90 | S | 0.140 | | |
| 27-May-90 | S | 0.104 | | 0.122 |
| 28-May-90 | M | 0.106 | | |
| 29-May-90 | T | 0.256 | | |
| 30-May-90 | W | 0.242 | | |
| 31-May-90 | T | 0.280 | | |
| 01-Jun-90 | F | 0.262 | 0.2292 | |
| 02-Jun-90 | S | 0.146 | | |
| 03-Jun-90 | S | 0.132 | | 0.139 |
| 04-Jun-90 | M | 0.208 | | |

| Date | Day | Flow (mgd) | Avg M-F Flow (mgd) | Avg S-S Flow (mgd) |
|---|---|---|---|---|
| 05-Jun-90 | T | 0.208 | | |
| 06-Jun-90 | W | 0.306 | | |
| 07-Jun-90 | T | 0.244 | | |
| 08-Jun-90 | F | 0.216 | 0.2364 | |
| 09-Jun-90 | S | 0.124 | | |
| 10-Jun-90 | S | 0.110 | | 0.117 |
| 11-Jun-90 | M | 0.216 | | |
| 12-Jun-90 | T | 0.224 | | |
| 13-Jun-90 | W | 0.214 | | |
| 14-Jun-90 | T | 0.212 | | |
| 15-Jun-90 | F | 0.214 | 0.216 | |
| 16-Jun-90 | S | 0.110 | | |
| 17-Jun-90 | S | 0.140 | | 0.125 |
| 18-Jun-90 | M | 0.192 | | |
| 19-Jun-90 | T | 0.168 | | |
| 20-Jun-90 | W | 0.252 | | |
| 21-Jun-90 | T | 0.206 | | |
| 22-Jun-90 | F | 0.210 | 0.2056 | |
| 23-Jun-90 | S | 0.146 | | |
| 24-Jun-90 | S | 0.116 | | 0.131 |
| 25-Jun-90 | M | 0.202 | | |
| 26-Jun-90 | T | 0.194 | | |
| 27-Jun-90 | W | 0.216 | | |
| 28-Jun-90 | T | 0.242 | | |
| 29-Jun-90 | F | 0.284 | 0.2276 | |
| 30-Jun-90 | S | 0.086 | | |
| 01-Jul-90 | S | 0.112 | | 0.099 |
| 02-Jul-90 | M | 0.190 | | |
| 03-Jul-90 | T | 0.208 | | |
| 04-Jul-90 | W | 0.126 | | |
| 05-Jul-90 | T | 0.160 | | |
| 06-Jul-90 | F | 0.284 | 0.1936 | |
| 07-Jul-90 | S | 0.166 | | |
| 08-Jul-90 | S | 0.166 | | 0.166 |
| 09-Jul-90 | M | 0.258 | | |
| 10-Jul-90 | T | 0.294 | | |
| 11-Jul-90 | W | 0.268 | | |
| 12-Jul-90 | T | 0.230 | | |
| 13-Jul-90 | F | 0.276 | 0.2652 | |
| 14-Jul-90 | S | 0.198 | | |
| 15-Jul-90 | S | 0.120 | | 0.159 |
| 16-Jul-90 | M | 0.232 | | |
| 17-Jul-90 | T | 0.256 | | |
| 18-Jul-90 | W | 0.257 | | |
| 19-Jul-90 | T | 0.288 | | |
| 20-Jul-90 | F | 0.294 | 0.2654 | |
| 21-Jul-90 | S | 0.242 | | |
| 22-Jul-90 | S | 0.196 | | 0.219 |
| 23-Jul-90 | M | 0.266 | | |
| 24-Jul-90 | T | 0.250 | | |
| 25-Jul-90 | W | 0.242 | | |
| 26-Jul-90 | T | 0.256 | | |

| Date | Day | Flow (mgd) | Avg M-F Flow (mgd) | Avg S-S Flow (mgd) |
|---|---|---|---|---|
| 27-Jul-90 | F | 0.306 | 0.264 | |
| 28-Jul-90 | S | 0.222 | | |
| 29-Jul-90 | S | 0.178 | | 0.2 |
| 30-Jul-90 | M | 0.220 | | |
| 31-Jul-90 | T | 0.220 | | |
| 01-Aug-90 | W | 0.262 | | |
| 02-Aug-90 | T | 0.272 | | |
| 03-Aug-90 | F | 0.284 | 0.2516 | |
| 04-Aug-90 | S | 0.230 | | |
| 05-Aug-90 | S | 0.178 | | 0.204 |
| 06-Aug-90 | M | 0.224 | | |
| 07-Aug-90 | T | 0.258 | | |
| 08-Aug-90 | W | 0.224 | | |
| 09-Aug-90 | T | 0.230 | | |
| 10-Aug-90 | F | 0.274 | 0.242 | |
| 11-Aug-90 | S | 0.168 | | |
| 12-Aug-90 | S | 0.166 | | 0.167 |
| 13-Aug-90 | M | 0.220 | | |
| 14-Aug-90 | T | 0.256 | | |
| 15-Aug-90 | W | 0.254 | | |
| 16-Aug-90 | T | 0.246 | | |
| 17-Aug-90 | F | 0.240 | 0.2432 | |
| 18-Aug-90 | S | 0.200 | | |
| 19-Aug-90 | S | 0.182 | | 0.191 |
| 20-Aug-90 | M | 0.200 | | |
| 21-Aug-90 | T | 0.276 | | |
| 22-Aug-90 | W | 0.276 | | |
| 23-Aug-90 | T | 0.224 | | |
| 24-Aug-90 | F | 0.286 | | |
| 25-Aug-90 | S | 0.202 | | |
| 26-Aug-90 | S | 0.172 | | 0.187 |
| 27-Aug-90 | M | 0.236 | | |
| 28-Aug-90 | T | 0.234 | | |
| 29-Aug-90 | W | 0.220 | | |
| 30-Aug-90 | T | 0.230 | | |
| 31-Aug-90 | F | 0.232 | 0.2304 | |

| | | | |
|---|---|---|---|
| M-F Avg | | 0.220 | |
| S-S Avg | | | 0.131 |
| YTD Avg | 0.196 | | |
| Max | 0.382 | | |
| Min | 0.038 | | |

B

# APPENDIX B

# SANITARY TREATMENT PLANT

# WASTEWATER QUALITY DATA

| Date Collected | Day | BOD5 (mg/L) | Ammonia as N (mg/L) | TKN (mg/L) | Alkalinity Grab as CaCO3 (mg/L) | Temp Grab C | pH Composite |
|---|---|---|---|---|---|---|---|
| 25-Jul-90 | Tue | 94 | 35 | 32 | 163.6 | 22.0 | 8.0 |
| 26-Jul-90 | Wed | 100 | 40 | 45 | 170.4 | 24.0 | 7.9 |
| 27-Jul-90 | Thu | 59 | 36 | 43 | 138.4 | 24.0 | 7.7 |
| 28-Jul-90 | Fri | | | | 118.6 | 22.5 | |
| 29-Jul-90 | Sat | 19 | 6 | 12 | 97.4 | 20.0 | 7.3 |
| 30-Jul-90 | Sun | 30 | 6 | 29 | 122.8 | 20.0 | 7.0 |
| 31-Jul-90 | Mon | 160 | 65 | 61 | 121.2 | 20.6 | 8.2 |
| 01-Aug-90 | Tue | 110 | 32 | 48 | 131.8 | 21.5 | 7.7 |
| 02-Aug-90 | Wed | 110 | 41 | 40 | 110.0 | 20.8 | 7.7 |
| 03-Aug-90 | Thu | 100 | 32 | 30 | 106.6 | 20.8 | 7.7 |
| 04-Aug-90 | Fri | 87 | 18 | 18 | 106.0 | 20.3 | 7.4 |
| 05-Aug-90 | Sat | 21 | 5 | 4 | 92.8 | 18.7 | 7.7 |
| 06-Aug-90 | Sun | 20 | 5 | 3 | 130.6 | 18.9 | 7.8 |
| 07-Aug-90 | Mon | 86 | 21 | 34 | 136.2 | 19.8 | 7.8 |
| 08-Aug-90 | Tue | 170 | 16 | 16 | 118.8 | 19.6 | 7.9 |
| 09-Aug-90 | Wed | 130 | 21 | 40 | 112.6 | 20.7 | 7.7 |
| 10-Aug-90 | Thu | 80 | 20 | 49 | 127.0 | 22.8 | 7.4 |
| 11-Aug-90 | Fri | 30 | 16 | 25 | 107.0 | 21.0 | 7.7 |
| 12-Aug-90 | Sat | 40 | 6 | 14 | 85.4 | 19.7 | 7.0 |
| 13-Aug-90 | Sun | 33 | 5 | 11 | 130.8 | 20.2 | 7.4 |
| 14-Aug-90 | Mon | 89 | 21 | 30 | 102.8 | 20.0 | 7.6 |
| 15-Aug-90 | Tue | 100 | 20 | 23 | 115.4 | 21.7 | 7.5 |
| 16-Aug-90 | Wed | 56 | 21 | 29 | 119.8 | 22.1 | 7.9 |
| 17-Aug-90 | Thu | 56 | 20 | 34 | 120.0 | 22.8 | 7.9 |
| 18-Aug-90 | Fri | 43 | 12 | 19 | 96.8 | 21.3 | 7.4 |
| 19-Aug-90 | Sat | 49 | 5 | 10 | 80.4 | 20.2 | 7.4 |
| 20-Aug-90 | Sun | 24 | 5 | 10 | 110.8 | 19.8 | 7.2 |
| 21-Aug-90 | Mon | 180 | 24 | 28 | | | |
| 22-Aug-90 | Tue | 110 | 20 | 23 | | | |
| 23-Aug-90 | Wed | 89 | | 24 | | | |
| 24-Aug-90 | Thu | 200 | | | | | |
| | Avg | 82.50 | 20.50 | 27.03 | 117.56 | 21.0 | 7.61 |
| | Max | >180 | 65 | 61 | 170.4 | 24 | 8.2 |
| | Min | 19 | 5 | 3 | 80.4 | 18.7 | 7 |

NSC No Samples Collected
BOD5 Reporting limit: 2 mg/L
TKN Reporting limit: 1 mg/L
NH4 as N Reporting limit: 0.5 mg/L
24-Aug-90 BOD5 was reported as greater than 180 mg/l

21-Aug-90

Rocky Flats STP Influent Composite Sampling

| Sample NO. | Date Collected | Day | TDS (mg/L) | Cl- (mg/L) | Nitrate/ Nitrate as N (mg/L) | Ortho-Phosphate (mg/L) | Total P (mg/L) | Sulphate (mg/L) | O&G (mg/L) |
|---|---|---|---|---|---|---|---|---|---|
| 60000 | 25-Jul-90 | Tue | | | | | | | |
| 60001 | 26-Jul-90 | Wed | | | | | | | |
| 60002 | 27-Jul-90 | Thu | | | | | | | |
| NSC | 28-Jul-90 | Fri | | | | | | | |
| 60004 | 29-Jul-90 | Sat | | | | | | | |
| 60005 | 30-Jul-90 | Sun | | | | | | | |
| 60006 | 31-Jul-90 | Mon | | | | | | | |
| 60007 | 01-Aug-90 | Tue | | | | | | | |
| 60008 | 02-Aug-90 | Wed | | | | | | | |
| 60009 | 03-Aug-90 | Thu | | | | | | | |
| 60010 | 04-Aug-90 | Fri | | | | | | | |
| 60011 | 05-Aug-90 | Sat | | | | | | | |
| 60012 | 06-Aug-90 | Sun | | | | | | | |
| 60013 | 07-Aug-90 | Mon | 180 | 39 | 0.6 | | 12 | | 29 |
| 60014 | 08-Aug-90 | Tue | 180 | 36 | | | 12 | 17 | 40 |
| 60015 | 09-Aug-90 | Wed | 190 | | 0.4 | | 7.1 | 14 | 25 |
| 60016 | 10-Aug-90 | Thu | 200 | 35 | | 7.9 | 8.8 | 16 | 37 |
| 60017 | 11-Aug-90 | Fri | 180 | 42 | 0.9 | 6.4 | | 18 | 11 |
| 60018 | 12-Aug-90 | Sat | 170 | 23 | 2.2 | 2.4 | | 19 | |
| 60019 | 13-Aug-90 | Sun | 140 | 40 | 1.6 | 1.8 | 3.9 | 17 | 20 |
| 60020 | 14-Aug-90 | Mon | 220 | 48 | 0.4 | 7.5 | | 24 | 44 |
| 60021 | 15-Aug-90 | Tue | | | | | | | |
| 60022 | 16-Aug-90 | Wed | | | | | | | |
| 60023 | 17-Aug-90 | Thu | | | | | | | |
| 60024 | 18-Aug-90 | Fri | | | | | | | |
| 60025 | 19-Aug-90 | Sat | | | | | | | |
| 60026 | 20-Aug-90 | Sun | | | | | | | |
| 60027 | 21-Aug-90 | Mon | | | | | | | |
| 60028 | 22-Aug-90 | Tue | | | | | | | |
| 60029 | 23-Aug-90 | Wed | | | | | | | |
| 60030 | 24-Aug-90 | Thu | | | | | | | |
| | | Avg | 182.50 | 37.57 | 1.02 | 5.20 | 8.76 | 17.86 | 29.43 |
| | | Max | 220 | 48 | 2.2 | 7.9 | 12 | 24 | 44 |
| | | Min | 140 | 23 | 0.4 | 1.8 | 3.9 | 14 | 11 |

21-Aug-90

Rocky Flats STP Influent Composite Sampling

| Sample NO. | Date Collected | Day | Alpha (pCi/L) | +/- 2 sig LLD | Beta (pCi/L) | +/- 2 sig LLD |
|---|---|---|---|---|---|---|
| 60000 | 25-Jul-90 | Tue | | | | |
| 60001 | 26-Jul-90 | Wed | | | | |
| 60002 | 27-Jul-90 | Thu | | | | |
| NSC | 28-Jul-90 | Fri | | | | |
| 60004 | 29-Jul-90 | Sat | | | | |
| 60005 | 30-Jul-90 | Sun | | | | |
| 60006 | 31-Jul-90 | Mon | | | | |
| 60007 | 01-Aug-90 | Tue | | | | |
| 60008 | 02-Aug-90 | Wed | | | | |
| 60009 | 03-Aug-90 | Thu | | | | |
| 60010 | 04-Aug-90 | Fri | | | | |
| 60011 | 05-Aug-90 | Sat | | | | |
| 60012 | 06-Aug-90 | Sun | | | | |
| 60013 | 07-Aug-90 | Mon | 4.47 | 2.41 | 12.2 | 1.67 |
| 60014 | 08-Aug-90 | Tue | 1.55 | 1.37 | 13.24 | 1.67 |
| 60015 | 09-Aug-90 | Wed | 0.51 | 1.1 | 11.3 | 1.59 |
| 60016 | 10-Aug-90 | Thu | 1.18 | 1.26 | 22.2 | 2.03 |
| 60017 | 11-Aug-90 | Fri | 1.03 | 1.22 | 11.02 | 1.58 |
| 60018 | 12-Aug-90 | Sat | 1.24 | 1.15 | 4.58 | 1.24 |
| 60019 | 13-Aug-90 | Sun | 1.16 | 1.21 | 5.45 | 1.29 |
| 60020 | 14-Aug-90 | Mon | 0.96 | 1.55 | 13.17 | 1.7 |
| 60021 | 15-Aug-90 | Tue | | | | |
| 60022 | 16-Aug-90 | Wed | | | | |
| 60023 | 17-Aug-90 | Thu | | | | |
| 60024 | 18-Aug-90 | Fri | | | | |
| 60025 | 19-Aug-90 | Sat | | | | |
| 60026 | 20-Aug-90 | Sun | | | | |
| 60027 | 21-Aug-90 | Mon | | | | |
| 60028 | 22-Aug-90 | Tue | | | | |
| 60029 | 23-Aug-90 | Wed | | | | |
| 60030 | 24-Aug-90 | Thu | | | | |
| | | Avg | 1.51 | | 11.65 | |
| | | Max | 4.47 | | 22.2 | |
| | | Min | 0.51 | | 4.58 | |

21-Aug-90

Rocky Flats STP Influent Composite Sampling

| Sample NO. | Date Collected | Day | Al (ug/L) | Sb (ug/L) | As (ug/L) | Ba (ug/L) | Be (ug/L) | Cd (ug/L) | Ca (ug/L) |
|---|---|---|---|---|---|---|---|---|---|
| 60000 | 25-Jul-90 | Tue | | | | | | | |
| 60001 | 26-Jul-90 | Wed | | | | | | | |
| 60002 | 27-Jul-90 | Thu | | | | | | | |
| NSC | 28-Jul-90 | Fri | | | | | | | |
| 60004 | 29-Jul-90 | Sat | | | | | | | |
| 60005 | 30-Jul-90 | Sun | | | | | | | |
| 60006 | 31-Jul-90 | Mon | | | | | | | |
| 60007 | 01-Aug-90 | Tue | | | | | | | |
| 60008 | 02-Aug-90 | Wed | | | | | | | |
| 60009 | 03-Aug-90 | Thu | | | | | | | |
| 60010 | 04-Aug-90 | Fri | | | | | | | |
| 60011 | 05-Aug-90 | Sat | | | | | | | |
| 60012 | 06-Aug-90 | Sun | | | | | | | |
| 60013 | 07-Aug-90 | Mon | 1110 | U | 2.2 | 85.4 | U | U | 29400 |
| 60014 | 08-Aug-90 | Tue | 1820 | U | 1.3 | 45.3 | U | U | 27500 |
| 60015 | 09-Aug-90 | Wed | 538 | U | 1.6 | 50.3 | U | U | 30300 |
| 60016 | 10-Aug-90 | Thu | 355 | U | U | 34.3 | U | U | 25400 |
| 60017 | 11-Aug-90 | Fri | 405 | U | 2 | 44.3 | U | U | 29300 |
| 60018 | 12-Aug-90 | Sat | 378 | U | U | 46.8 | U | U | 32100 |
| 60019 | 13-Aug-90 | Sun | 399 | U | 2.1 | 42.2 | U | U | 30300 |
| 60020 | 14-Aug-90 | Mon | 416 | U | 2.6 | 41.3 | U | U | 29200 |
| 60021 | 15-Aug-90 | Tue | | | | | | | |
| 60022 | 16-Aug-90 | Wed | | | | | | | |
| 60023 | 17-Aug-90 | Thu | | | | | | | |
| 60024 | 18-Aug-90 | Fri | | | | | | | |
| 60025 | 19-Aug-90 | Sat | | | | | | | |
| 60026 | 20-Aug-90 | Sun | | | | | | | |
| 60027 | 21-Aug-90 | Mon | | | | | | | |
| 60028 | 22-Aug-90 | Tue | | | | | | | |
| 60029 | 23-Aug-90 | Wed | | | | | | | |
| 60030 | 24-Aug-90 | Thu | | | | | | | |
| | | Avg | 677.63 | 0.00 | 1.48 | 48.74 | 0.00 | 0.00 | 29187.50 |
| | | Max | 1820 | 0 | 2.6 | 85.4 | 0 | 0 | 32100 |
| | | Min | 355 | 0 | 0 | 34.3 | 0 | 0 | 25400 |

21-Aug-90

Rocky Flats STP Influent Composite Sampling

| Sample NO. | Date Collected | Day | Cr (ug/L) | Co (ug/L) | Cu (ug/L) | Fe (ug/L) | Pb (ug/L) | Mg (ug/L) | Mn (ug/L) |
|---|---|---|---|---|---|---|---|---|---|
| 60000 | 25-Jul-90 | Tue | | | | | | | |
| 60001 | 26-Jul-90 | Wed | | | | | | | |
| 60002 | 27-Jul-90 | Thu | | | | | | | |
| NSC | 28-Jul-90 | Fri | | | | | | | |
| 60004 | 29-Jul-90 | Sat | | | | | | | |
| 60005 | 30-Jul-90 | Sun | | | | | | | |
| 60006 | 31-Jul-90 | Mon | | | | | | | |
| 60007 | 01-Aug-90 | Tue | | | | | | | |
| 60008 | 02-Aug-90 | Wed | | | | | | | |
| 60009 | 03-Aug-90 | Thu | | | | | | | |
| 60010 | 04-Aug-90 | Fri | | | | | | | |
| 60011 | 05-Aug-90 | Sat | | | | | | | |
| 60012 | 06-Aug-90 | Sun | | | | | | | |
| 60013 | 07-Aug-90 | Mon | 16.5 | U | 92.6 | 1920 | 11.3 | 5340 | 65.2 |
| 60014 | 08-Aug-90 | Tue | U | U | 34.7 | 721 | 8.7 | 5060 | 38.7 |
| 60015 | 09-Aug-90 | Wed | U | U | 41.8 | 989 | 8.8 | 5660 | 45.1 |
| 60016 | 10-Aug-90 | Thu | U | U | 24.8 | 487 | U | 4830 | 33.1 |
| 60017 | 11-Aug-90 | Fri | U | U | 32.5 | 499 | 2.8 | 5600 | 40.1 |
| 60018 | 12-Aug-90 | Sat | U | U | 88.5 | 716 | 4.9 | 5860 | 42.4 |
| 60019 | 13-Aug-90 | Sun | U | U | 34 | 462 | 2.6 | 5540 | 39.8 |
| 60020 | 14-Aug-90 | Mon | U | U | 74 | 745 | 3.1 | 5780 | 48.6 |
| 60021 | 15-Aug-90 | Tue | | | | | | | |
| 60022 | 16-Aug-90 | Wed | | | | | | | |
| 60023 | 17-Aug-90 | Thu | | | | | | | |
| 60024 | 18-Aug-90 | Fri | | | | | | | |
| 60025 | 19-Aug-90 | Sat | | | | | | | |
| 60026 | 20-Aug-90 | Sun | | | | | | | |
| 60027 | 21-Aug-90 | Mon | | | | | | | |
| 60028 | 22-Aug-90 | Tue | | | | | | | |
| 60029 | 23-Aug-90 | Wed | | | | | | | |
| 60030 | 24-Aug-90 | Thu | | | | | | | |
| | | Avg | 2.06 | 0.00 | 52.86 | 817.38 | 5.28 | 5458.75 | 44.13 |
| | | Max | 16.5 | 0 | 92.6 | 1920 | 11.3 | 5860 | 65.2 |
| | | Min | 0 | 0 | 24.8 | 462 | 0 | 4830 | 33.1 |

21-Aug-90

Rocky Flats STP Influent Composite Sampling

| Sample NO. | Date Collected | Day | Hg (ug/L) | Ni (ug/L) | K (ug/L) | Se (ug/L) | Ag (ug/L) | Na (ug/L) | Tl (ug/L) |
|---|---|---|---|---|---|---|---|---|---|
| 60000 | 25-Jul-90 | Tue | | | | | | | |
| 60001 | 26-Jul-90 | Wed | | | | | | | |
| 60002 | 27-Jul-90 | Thu | | | | | | | |
| NSC | 28-Jul-90 | Fri | | | | | | | |
| 60004 | 29-Jul-90 | Sat | | | | | | | |
| 60005 | 30-Jul-90 | Sun | | | | | | | |
| 60006 | 31-Jul-90 | Mon | | | | | | | |
| 60007 | 01-Aug-90 | Tue | | | | | | | |
| 60008 | 02-Aug-90 | Wed | | | | | | | |
| 60009 | 03-Aug-90 | Thu | | | | | | | |
| 60010 | 04-Aug-90 | Fri | | | | | | | |
| 60011 | 05-Aug-90 | Sat | | | | | | | |
| 60012 | 06-Aug-90 | Sun | | | | | | | |
| 60013 | 07-Aug-90 | Mon | U | U | 10000 | 2.6 | 12.3 | 28400 | U |
| 60014 | 08-Aug-90 | Tue | U | U | 11500 | U | 5.7 | 23900 | U |
| 60015 | 09-Aug-90 | Wed | U | U | 14000 | 1.4 | 4.1 | 29200 | U |
| 60016 | 10-Aug-90 | Thu | U | U | 10000 | U | 6.8 | 26700 | U |
| 60017 | 11-Aug-90 | Fri | 0.8 | U | 10900 | U | U | 25000 | U |
| 60018 | 12-Aug-90 | Sat | 0.6 | U | 5170 | U | U | 17800 | U |
| 60019 | 13-Aug-90 | Sun | U | U | 5100 | U | U | 17200 | U |
| 60020 | 14-Aug-90 | Mon | U | U | 14700 | 2.6 | 3.4 | 32600 | U |
| 60021 | 15-Aug-90 | Tue | | | | | | | |
| 60022 | 16-Aug-90 | Wed | | | | | | | |
| 60023 | 17-Aug-90 | Thu | | | | | | | |
| 60024 | 18-Aug-90 | Fri | | | | | | | |
| 60025 | 19-Aug-90 | Sat | | | | | | | |
| 60026 | 20-Aug-90 | Sun | | | | | | | |
| 60027 | 21-Aug-90 | Mon | | | | | | | |
| 60028 | 22-Aug-90 | Tue | | | | | | | |
| 60029 | 23-Aug-90 | Wed | | | | | | | |
| 60030 | 24-Aug-90 | Thu | | | | | | | |
| | | Avg | 0.18 | 0.00 | 10171.25 | 0.83 | 4.04 | 25100.00 | 0.00 |
| | | Max | 0.8 | 0 | 14700 | 2.6 | 12.3 | 32600 | 0 |
| | | Min | 0 | 0 | 5100 | 0 | 0 | 17200 | 0 |

21-Aug-90

Rocky Flats STP Influent Composite Sampling

| Sample NO. | Date Collected | Day | V (ug/L) | Zn (ug/L) |
|---|---|---|---|---|
| 60000 | 25-Jul-90 | Tue | | |
| 60001 | 26-Jul-90 | Wed | | |
| 60002 | 27-Jul-90 | Thu | | |
| NSC | 28-Jul-90 | Fri | | |
| 60004 | 29-Jul-90 | Sat | | |
| 60005 | 30-Jul-90 | Sun | | |
| 60006 | 31-Jul-90 | Mon | | |
| 60007 | 01-Aug-90 | Tue | | |
| 60008 | 02-Aug-90 | Wed | | |
| 60009 | 03-Aug-90 | Thu | | |
| 60010 | 04-Aug-90 | Fri | | |
| 60011 | 05-Aug-90 | Sat | | |
| 60012 | 06-Aug-90 | Sun | | |
| 60013 | 07-Aug-90 | Mon | U | 482 |
| 60014 | 08-Aug-90 | Tue | U | 262 |
| 60015 | 09-Aug-90 | Wed | U | 254 |
| 60016 | 10-Aug-90 | Thu | U | 166 |
| 60017 | 11-Aug-90 | Fri | U | 196 |
| 60018 | 12-Aug-90 | Sat | U | 359 |
| 60019 | 13-Aug-90 | Sun | U | 224 |
| 60020 | 14-Aug-90 | Mon | 14.3 | 249 |
| 60021 | 15-Aug-90 | Tue | | |
| 60022 | 16-Aug-90 | Wed | | |
| 60023 | 17-Aug-90 | Thu | | |
| 60024 | 18-Aug-90 | Fri | | |
| 60025 | 19-Aug-90 | Sat | | |
| 60026 | 20-Aug-90 | Sun | | |
| 60027 | 21-Aug-90 | Mon | | |
| 60028 | 22-Aug-90 | Tue | | |
| 60029 | 23-Aug-90 | Wed | | |
| 60030 | 24-Aug-90 | Thu | | |
| | | Avg | 1.79 | 274.00 |
| | | Max | 14.3 | 482 |
| | | Min | 0 | 166 |

## EG&G

| VISTA ID | EG&G ID | Date/Time | TKN | NH4 | BOD |
|---|---|---|---|---|---|
| | | | | All in mg/L | |
| 902609-008 | SW60032WC | 6-7AM | 7.0 | 7.4 | 52 |
| 902609-009 | SW60033WC | 7-8AM | 12 | 7.0 | 38 |
| 902609-010 | SW60034WC | 8-9AM | 19 | 10 | 140 |
| 902609-011 | SW60035WC | 9-10AM | 35 | 16 | 230 |
| 902609-012 | SW60036WC | 10-11AM | 26 | 21 | 220 |
| 902609-013 | SW60037WC | 11-12AM | 35 | 30 | 230 |
| 902609-014 | SW60038WC | 12-1PM | 39 | 34 | 260 |
| 902609-015 | SW60039WC | 1-2PM | 60 | 34 | 250 |
| 902620-003 | SW60040WC | 2-3PM | 43 | 38 | > 180 |
| 902620-004 | SW60041WC | 3-4PM | 46 | 39 | > 180 |
| 902620-005 | SW60042WC | 4-5PM | 36 | 36 | > 180 |
| 902620-006 | SW60043WC | 5-6PM | 38 | 41 | > 180 |
| 902620-007 | SW60044WC | 6-7PM | 36 | 33 | > 180 |
| 902620-008 | SW60045WC | 7-8PM | 32 | 17 | > 180 |
| 902620-009 | SW60046WC | 8-9PM | 31 | 28 | > 180 |
| 902620-010 | SW60047WC | 9-10PM | 27 | 27 | > 180 |
| 902620-011 | SW60048WC | 10-11PM | 26 | 21 | > 180 |
| 902620-012 | SW60049WC | 11-12PM | 22 | 19 | > 180 |
| 902620-013 | SW60050WC | 12-1AM | 19 | 17 | 130 |
| 902620-014 | SW60051WC | 1-2AM | 22 | 13 | 120 |
| 902620-015 | SW60052WC | 2-3AM | 15 | 12 | 83 |
| 902620-016 | SW60053WC | 3-4AM | 12 | 11 | 100 |
| 902620-017 | SW60054WC | 4-5AM | 13 | 8.7 | 130 |
| 902620-018 | SW60055WC | 5-6AM | 10 | 9.0 | 120 |

> = Sample was analyzed at too high of an initial concentration - could not be reanalyzed within holding times.

C

# APPENDIX C

# SANITARY TREATMENT PLANT

# TOUR

V

**Form D-1**
**Preliminary Plant Information to Collect by Telephone**

Plant Name: Rocky Flats

Phone Contact: 303-966-4502

Position: Bill Burbridge — Senior Plant Operator

Phone. No.: 966-4502  Date: 7-29-90

Design Flow: 0.5 MGD (Both systems)  Current Flow: Average .25 MGD

Service Population:

Year Plant Built: 1951  Most Recent Upgrade: 1985-1986

Directions to Plant: East side of RFP, Inside the plant, North of Gate 9 Guard post.

Major Processes (type and size): "Muffin Monster" in use before Basins

Preliminary Treatment: Preaeration - Flow equalization Basins (60,000 gals each)

Primary Treatment: 2 rectangular pri. clarifiers (#1-12,768 Gals. & #2-27,586 Gals.)

Secondary Treatment

Aeration Basin: 2 Aer. Basins (#1-47,393 Gals. & #2-65,450 Gals.)

Trickling Filter: N/A

Clarifier: 2 Sec. Clarifiers (#1-approx. 40,212 Gals. & #2-Approx. 53,235 Gals.)

Series Disinfection: 2 chlorine contact basins - (#1-1,481 Gals. [$Cl_2$ inject.] & #2-3,246 Gals.)

Unusual Processes or Equipment: Tertiary treatment in use, consisting of 1 clarifier with addition of Alum & Polymer, clarifier Cap.-76,284 Gals. followed by 3 pressure mixed media sand filters in parallel. wet well (before sand filters) cap. -4308 Gals. — Clear well (after sand filts.) cap. -2,394 Gals

Any processes or equipment currently not operational: Yes. 990 prearation basin - "South" not used, #1 primary clarifier, #1 Aeration basin, and #1 Secondary clarifier. The #1 Aeration basin is used presently to simply Aerate the Anaerobic Digester supernatant Before pumping supernatant to head of plant.

nal Info. - #1 Anaerobic Digester Cap. - 45,089 Gals. & #2 Anerobic Digester Cap. - 46,189 Gals

Who does performance monitoring tests? Environmental lab on Plantsite

Who does process control test? STP operators.

What process control and laboratory test equipment is available? Currently, the only equipment on Hand is simply a Centrifuge and Settleometers to perform Al West spin & Settles Test, along with equipment to run D.O. uptakes on activated sludge. Equipment is on Order To run many other test such as MLSS-MLVSS. We do currently run Micro-exams.

Plant coverage (8 am - 5 pm, 24 hr, etc.) 24 hrs. / Day 7 days / week.

Work hours of key individuals Will discuss in depth @ later date. The Shift hours and days vary, for certain indivs. working a 7 day non-rotating shift.

→ All Operators are state certified. (3-A opers. / 2-B opers.)

Known conflicts with scheduling fieldwork Plant Security

Contact for scheduling fieldwork Norm Fryback x4502, Don Ferrier, Bill Burbridge x4502

Administrator or owner (responsible official) Don Ferrier x2573

Who has records on the budget?. Don Ferrier

Who is consultant? Dr. Michael Richard

Information resources (availability):

As-built construction plans Fac. Eng.

O&M Manual STP operators & possibly Fac. Eng.

Monitoring records Clean water group.

Equipment literature STP operators.

Process control records STP operators & Dr. Michael Richard

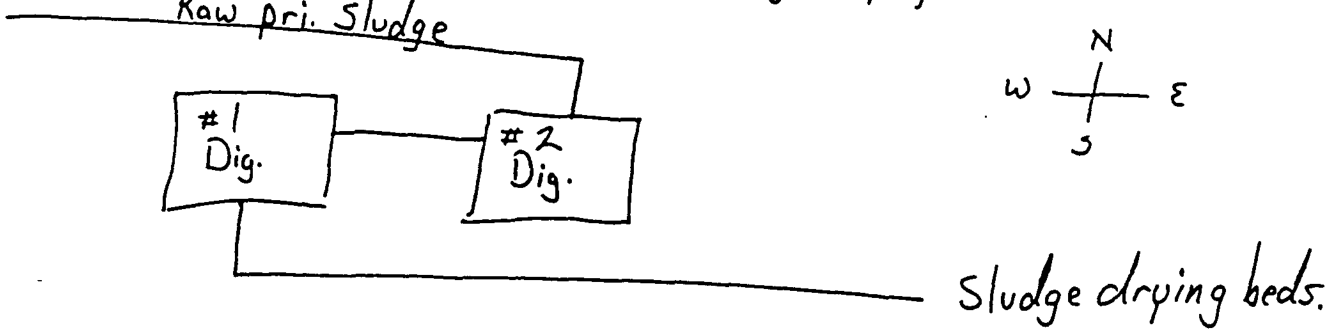
# Form D-3
# Design Data

**A. *Plant Flow Diagram*** (attach if available)

Attached

**B. *Plant Solids Handling Diagram*** (attach if available)

Raw pri. sludge pumped to #2 Anaer. Dig., overflow or equalized with #1 Anaer. Dig., Then pumped to sludge drying beds.




**C. *Upgrading and/or Expansion History*** (historical studies, current evaluations, proposed modifications, etc.)

1. Influent Instrumentation in place.
2. Effluent Instrumentation about to begin
3. Auto. chlorination /Dechlorination about to begin
4. Improved Sludge handling, (I.E. Mech. drying) being studied.

Please contact Mr. Dana Dixon - Sen. Devel. Engineer @ 966-2310 for any Details.

*D. Influent Characteristics*

| | | | | | | |
|---|---|---|---|---|---|---|
| Average Daily Flow: | Design | | mgd x 3,785 | = | | m³/d |
| | Current | .25 | mgd x 3,785 | = | | m³/d |
| aximum Daily Flow: | Design | .5 | mgd x 3,785 | = | | m³/d |
| | Current | .35 | mgd x 3,785 | = | | m³/d |
| Maximum Hourly Flow: Flow equalized | Design | | mgd x 3,785 | = | | m³/d |
| | Current | | mgd x 3,785 | = | | m³/d |
| Average Daily $BOD_5$: contact clean water group | Design | | lb x 0.454 | = | | kg |
| | Current | | lb x 0.454 | = | | kg |
| Average Daily TSS: Contact clean water group | Design | | lb x 0.454 | = | | kg |
| | Current | | lb x 0.454 | = | | kg |

Infiltration Inflow
contact
Fac. Eng.

Seasonal Variations – None except ~~gr~~ groundwater Infilt. and Temps.

Process
Major Industrial Wastes

| Name | Flow | $BOD_5$ Load | TSS Load | Other |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Collection System

Lift Stations

"2" Building Lift stations.

1. Building 771
2. Building 881 complex

Population Served

**Flow Measurement**
(Form for each flow measuring device)

Flow Stream Measured Effluent Via "V" notch weir and Stephens Total flow meter
Located in #1 $Cl_2$ contact basin.

Control Section:
Type and Size #1 Chlorine contact Basin

Location

Comments (operational problems, maintenance problems, unique features, preventive maintenance procedures, etc.):

1. Poor Aeration exists.
2. Very Low F/m
3. Ground water Infilt.
4. Very old equip.
5. Preventive maint. now being formed & initiated

*Recorder*
Name Stevens Total Flow meter Model 61-R

Flow Range 0 - .7 MGD

Calibration Frequency ~~Unknown~~ - ~~Possibly~~ on a quartarly basis

Date of Last Calibration 5-23-90 Due on 8-90

Totalizer Same

Comments (operation and design problems, unique features, etc.):

*Accuracy Check During CPE*
Method of Check:

Results:

**Pumping**
(Complete as many forms as necessary)

| Flow Stream Pumped | Type | No. of Pumps | Name | Model | hp | Capacity | Head |
|---|---|---|---|---|---|---|---|
| ...ary Sand Filters | | 2 | Peerless | 2626-278 | 7.5 | | |
| Filter pumps | | 2 | Peerless | 2626-278 | 5 | | |
| Backwash pumps | | | | | | | |
| | | | | | | | |

Comments: (flow control, suitability of installed equipment, results of capacity check, etc.)

| Flow Stream Pumped | Type | No. of Pumps | Name | Model | hp | Capacity | Head |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Comments:

| Flow Stream Pumped | Type | No. of Pumps | Name | Model | hp | Capacity | Head |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Comments:

**Preliminary Treatment**

*Mechanical Bar Screen*

Name Parkson Corp. — Aqua guard

Model AG - MN - A (N) Horsepower 3/4

Bar Screen Width 10" inch x 2.54 = ________ cm

Bar Spacing ________ inch, O.C. x 2.54 = ________ cm

Within Building? Yes Heated? NO

Description of Operation:

Out of Service

*Hand-Cleaned Bar Screen*

Bar Screen Width ________ inch x 2.54 = ________ cm

Bar Spacing ________ inch, O.C. x 2.54 = ________ cm

Cleaning Frequency ________

Within Building? ________ Heated ________

Description of Operation:

Not used
Bypass of Comminutors

*Screenings Volume:*

Normal ________ cu yd x 0.75 = ________ $m^3/d$

Peak ________ cu yd x 0.75 = ________ $m^3/d$

*Screenings Disposal*

*Comments*

## Preliminary Treatment

*Comminutor*

Name: Disposable Waste Systems Inc. Muffin Monster

Model: 30002-18 Horsepower: 2

Within Building? Yes Heated? No

Maintenance:

Comments: Very fine equip.

#1 Comminutor - Chicago pump Co., unknow model no. - 1/4 H.P. Located outdoors - out of Service. - Orig. Plant Equip.

#2 Comminutor - Infilco Degremont Inc. Mod.# 29563 - 1/2 HP. Located outdoors.

*Grit Removal*

Description of Unit: None

Grit Volume:

Normal ______ cu yd x 0.75 = ______ $m^3/d$

Peak ______ cu yd x 0.75 = ______ $m^3/d$

Disposal of Grit:

Comments:

E. *Unit Processes (continued)*

Contact Fac. Eng. for Design Prints on #1 & #2 Pri. Clarifiers.

**Primary Treatment**

*'mary Clarifier(s)*

Number ____________ Surface Dimensions ____________

____________

Water Depth (Shallowest) ________ ft x 0.3 = ________ m

Water Depth (Deepest) ________ ft x 0.3 = ________ m

Weir Location ____________

Weir Length ________ ft x 0.3 = ________ m

Total Surface Area ________ sq ft x 0.093 = ________ $m^2$

Total Volume ________ cu ft x 0.028 = ________ $m^3$

Flow (Design) ________ mgd x 3,785 = ________ $m^3/d$

(Operating) ________ mgd x 3,785 = ________ $m^3/d$

Weir Overflow Rate
(Design) ________ gpd/ft x 0.012 = ________ $m^3/m/d$

(Operating) ________ gpd/ft x 0.012 = ________ $m^3/m/d$

Surface Settling Rate
(Design) ________ gpd/sq ft x 0.04 = ________ $m^3/m^2/d$

(Operating) ________ gpd/sq ft x 0.04 = ________ $m^3/m^2/d$

Collector Mechanism Name ____________

Model ____________ Horsepower ____________

Scum Collection and Treatment:

Scum Volume:

Scum Treatment/Disposal:

Contact Fac. Eng. for design prints for #1 & #2 Aer. Basins

**SecondaryTreatment (Activated Sludge)**

*Aeration Basin(s)*

Number ____________ Surface Dimensions ____________

____________

Water Depth ____________ ft x 0.3 = ____________ m

Total Volume ____________ cu ft x 7.48 = ____________gal

Flow (Design) ____________ mgd x 3,785 = ____________ $m^3/d$

(Operating) ____________ mgd x 3,785 = ____________ $m^3/d$

Wastewater Detention Time (Design) ____________ hr

(Operating) ____________ hr

$BOD_5$ Loading
(Design) ____________ lb/d/1,000 cu ft x 0.16 = ____________ kg/m3//d

(Operating) ____________ lb/d/1,000 cu ft x 0.16 = ____________ $kg/m^3/d$

Covered? No

Comments: Contact Fac. Eng. for Design prints #1 & #2 sec. clarifiers.
Vols. stated earlier are a very rough fig.

Modes of Operation (current and other options; i.e., complete mix, plug flow, step loading, tapered aeration - sketch options):

E. *Unit Processes (continued)*

**Secondary Treatment (Oxygen Supply)**
4 Aerators Total

*Surface Mechanical Aeration*
[illegible]f Aerators 2 in each "A" Basin Name Aeration Industries Inc.

Model AES-7.5-3 Horsepower 7.5

Rated Capacity 2.5 lbs. $O_2$ per HP hr. lb/hr x 0.454 = ______ kg/hr

Speed Control: NO

Submergence Control: NO

*Diffused Aeration* Excess air from RSF Air lift blowers directed to Aeration Basins

Blowers
No. of Blowers ______ Name ______

Model ______ Horsepower ______

Capacity ______ cfm x 0.028 = ______ m³/min

Minimum Inlet Air Temperature ______

Diffusers
Types of Diffusers (coarse, fine, ceramic, stainless steel, etc.):

Manufacturer ______ Model ______

[illegible]er Depth ______

[illegible]d Standard Transfer Efficiency ______

Water Temperature (maximum) ______

Plant Elevation ______

*Jet Aeration*
No. of Aerators ______ Name ______

Model ______ Horsepower ______

Rated Capacity ______ lb/hr x 0.454 = ______ kg/hr

Controls:

*Comments*

NOTE: See Appendix F for procedure for converting standard oxygenation rates to actual oxygenation rates.

Contact Fac. Eng.

## SecondaryTreatment (Secondary Clarifiers)

Number ____________ Surface Dimensions ____________

Water Depth (Shallowest) #1 - 9'1" ~~[illegible]~~" ft x 0.3 = ________ m

Water Depth (Deepest) ________ ft x 0.3 = ________ m

Weir/Launder Location(s) ____________

Percent of Clarification Developed by Launders ____________

Weir Length ________ ft x 0.3 = ________ m

Weir Overflow Rate
(Design) ________ gpd/ft x 0.012 = ________ $m^3/m/d$

(Operating) ________ gpd/ft x 0.012 = ________ $m^3/m/d$

Total Surface Area ________ sq ft x 0.093 = ________ $m^2$

Total Volume ________ cu ft x 0.028 = ________ $m^3$

Flow (Design) ________ mgd x 3.785 = ________ $m^3/d$

(Operating) ________ mgd x 3.785 = ________ $m^3/d$

;ace Settling Rate
(Design) ________ gpd/sq ft x 0.04 = ________ $m^3/m^2/d$

(Operating) ________ gpd/sq ft x 0.04 = ________ $m^3/m^2/d$

Hydraulic Detention Time (Design ) ________ hr (Operating) ________ hr

(Actual From Dye Test) ________ hr

Collector Mechanism Name #1 - Air-O-Gest systems. #2 - Envirex

Model #1 - 707 #2 - F-7 Horsepower #1 - 1/2 #2 - 1

Return Sludge Collector Mechanism Type Air lift pumps

Mechanical Seal Location (center well?/collector arm?):

Scum Collection and Removal:

Scum Volume: Unknown
Normal ________ cu yd x 0.75 = ________ $m^3/d$

Peak ________ cu yd x 0.75 = ________ $m^3/d$

Scum Treatment/Disposal:
Anaerobic Digesters

Contact. Fac. Eng. for Design prints

## Chlorine Disinfection

*t Basin(s)*
umber ______________________________

Surface Dimensions ______________________________

Channel Length-to-Width Ratio __________ No. of Bends ______________________________

Water Depth __________ ft x 0.3 = __________ m

Total Volume __________ cu ft x 7.48 = __________ gal

Detention Time: (Design) __________ min (Operating) __________ min

Drain Capability: Yes on #1 No on #2

Scum Removal Capability: No

Comments: #2 Contact Basin has a Drain but this would discharge into S. Walnut creek, bypassing pond B-3.

*Chlorinator(s)*
Name Capital controls Number Advance 480

Capacity __________ lb/d x 0.454 = __________ kg/d

Type of Injection:
pumped Eff. water to ejector

Flow Proportioned? Not currently. Will be in near future.

Feed Rate (Operating) Approx. 10 lb/d x 0.454 = __________ kg/d

Dosage (Operating) 2.0 mg/l

Comments:
Dechlorination installed using $SO_2$

*E. Unit Processes (continued)*

## Sludge Handling Facilities

### Primary Sludge

*Description of Pumping Procedure (time clocks; variable speed pumps; etc.)* Pumped Once per shift. Manually

*Method of Sludge Volume Measurement* None currently

*Sampling Location*

*Sampling Procedure*

*Comments*

### Return Sludge

*Description of Sludge Movement (scrape to clarifier hopper; pump to aeration basin inlet channels; etc.)* Air lift pump to near A basin inlet

*Controllable Capacity Ranges*

(Low) 4 GPM ~~mgd~~ x 3,785 = ________ m3/d

(High) 223 GPM ~~mgd~~ x 3,785 = ________ m3/d

*Method of Control* Manual Ball valves

*Method of RAS Volume Measurement* Staff Guage on 22.5° V notch weir

*Sampling Location* Clarifier Return Sludge pit

*Sampling Procedure* Grab

*Comments*

### Waste Sludge

*Description of Waste Procedure (variable-speed pump wastes from separate clarifier hopper; continuous or by time clock; etc.)* Submersible pump located in Aeration Basins set up on Time clocks. Works very well!

*Method of Waste Volume Measurement* On time versus off time and GPM

*Sampling Location* # 2 Pri. Clarifier Or Aeration Basins

*Sampling Procedure*

*Comments* No samples currently taken to determine The MLSS for WAS.

Contact Fac. Eng.

**Treatment (Anaerobic Digestion)**

***Primary Digesters***

Number of Digesters 2 Diameter ________ ft x 0.3 = ________ m

Sidewall Depth ________ ft x 0.3 = ________ m

Center Depth ________ ft x 0.3 = ________ m

Total Volume ________ cu ft x 0.028 = ________ $m^3$

Floating Cover? ____________________

Flow (Design) ____________ mgd x 3,785 = ________ $m^3/d$

(Operating) ____________ mgd x 3,785 = ________ $m^3/d$

Detention Time (Design) ____________ days (Operating) ____________ days

Volatile Solids Loading (Design) ________ lb/cu ft x 16 = ________ $kg/m^3$

(Operating) ________ lb/cu ft x 16 = ________ $kg/m^3$

***Heating***

Manufacturer American Heat reclaiming Heat exch. Dayton Hot water heater Model Number MFG. # 15185 Type 1-H 3E 324 F

Capacity 360,000 ~~10^6~~ Btu/hr x 0.29 = ________ $10^6$ W

***Mixing***

Manufacturer Chicago pumps Type VPM Non Clog pumps Mod. # 61-22773

Number of Units 2 pumps

*Sampling Ports* None

*Mode of Operation* Dig. #2 heated to 90-95°F equalized with #1 Dig. Sludge withdrawl to D.B's from #1 Dig. (uncirculated within #1 Dig.)

*Gas System* Natural gas piped into STP

*Comments*

Could be considered #1 Dig.

## Treatment (Anaerobic Digestion)

*condary Digesters*

Number of Digesters ____________ Diameter ____________ ft x 0.3 = ____________ m

Sidewall Depth ____________ ft x 0.3 = ____________ m

Center Depth ____________ ft x 0.3 = ____________ m

Total Volume ____________ cu ft x 0.028 = ____________ $m^3$

Floating Cover? ____________________________

Flow (Design) ________________ mgd x 3,785 = ____________ $m^3/d$

(Operating) ________________ mgd x 3,785 = ____________ $m^3/d$

Detention Time (Design) ________________ days (Operating) ________________ days

Volatile Solids Loading (Design) ____________ lb/cu ft x 16 = ____________ $kg/m^3$

(Operating) ____________ lb/cu ft x 16 = ____________ $kg/m^3$

*Heating*

Manufacturer ____________________________ Model Number ____________________

Capacity ____________________ $10^6$ Btu/hr x 0.29 = ________________ $10^6$ W

*Mixing*

Manufacturer ____________________________ Type ____________________________

Number of Units ____________________

*Sampling Ports*

*Mode of Operation*

*Gas System*

*Comments*

Please see attatched

E. Unit Processes (continued)

**Dewatering**

*'dge Drying Beds*

Number of Beds Dimensions (ea) ____________ Surface Area (Total) ____________

Covered? ~~(Glass?)~~ ~~(Plastic?)~~ Yes - Metal prefab Subnatant Drain To Head of STP or #1 Aer. basin

Dewatered Sludge Removal:

#1 drying bed utilizing 1' sq. tiles manufactured by Gravity Flow Syst.

Mode of Operation (depth of sludge draw; seasonal operation; etc.):

Fill to 1' or less

Heating is not installed in D.B. buildings. Drying times are dependent on O.S. Temp. & Weather.

Comments:

Sludge handling currently is our worst problem

Digesters fill to max. Eff. $BOD_5$ violations have occured because of this problem

*Other Dewatering Unit(s)*

Type(s) of Unit(s) None curently

Number of Units ____________ Manufacturer ____________

Model ____________ Horsepower ____________

Loading Rate (Design) ____________ lb/hr x 0.454 = ____________ kg/hr

(Operating) ____________ lb/hr x 0.454 = ____________ kg/hr

Polymer Used ____________

lb/dry ton ____________ x 0.5 = ____________ g/kg

Cake Solids (Design) ____________ percent solids

(Operating) ____________ percent solids

Hours of Operation (Design) ____________ hr/wk

(Operating) ____________ hr/wk

Comments:

## Ultimate Disposal

*e Procedure*

*al Operation*

*nts*

## F. Other Design Information

*Standby Power (description of unit; automatic activation? capacity for which processes? frequency of use; etc.)*

None

*Alarm Systems (description of system; units covered; etc.)*

Respirometer (on line) installed but not yet inservice
PH on Inf. – Eff. later
Conductivity on Inf. – Eff. later
Hydrocarbon detectors on Inf.
Please contact Mr. Dana Dixon for Details.

*Plant Automation (description of any plant automation not covered under more specific topics)*

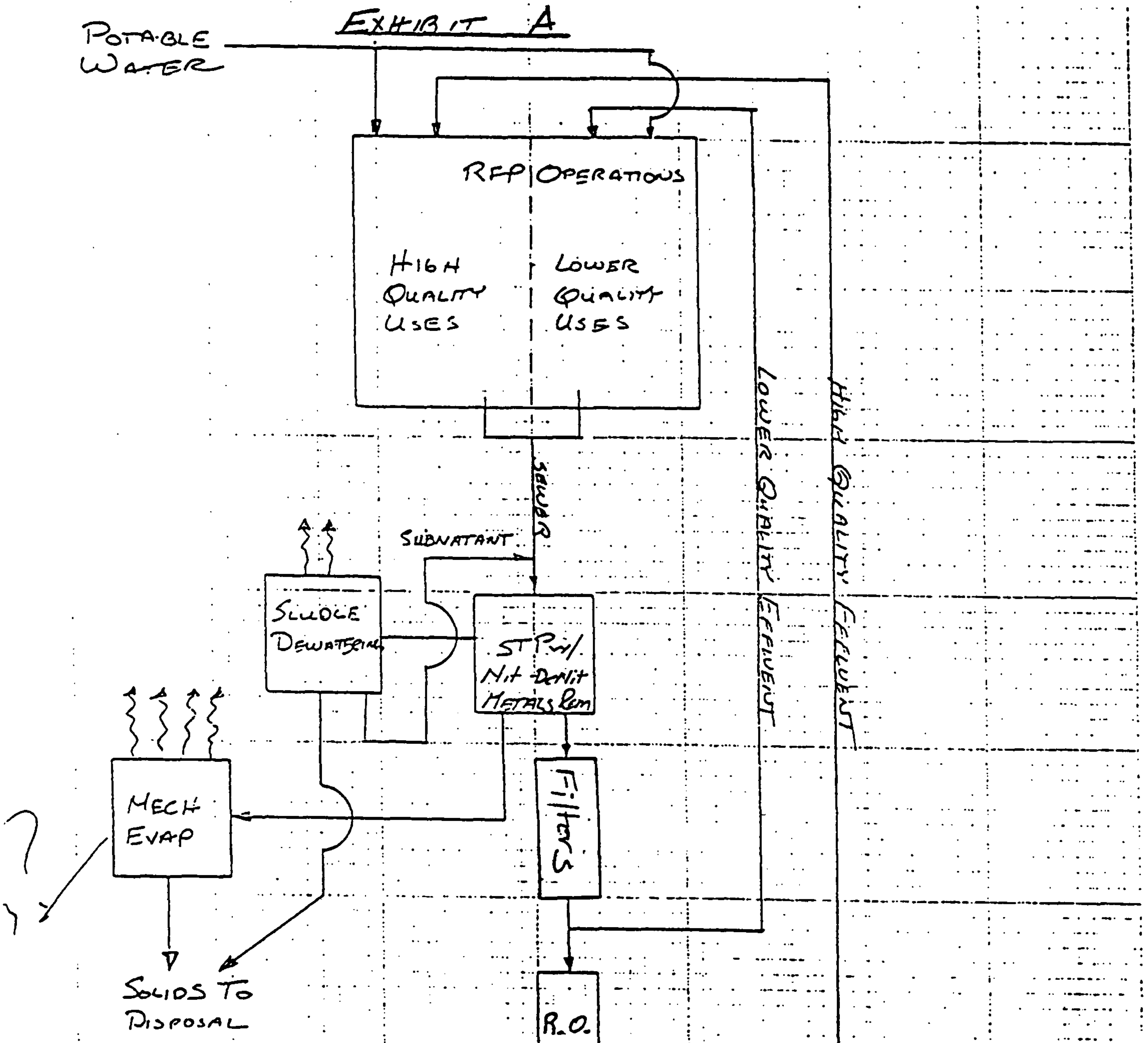
None except Flow control using a pinch valve and magnetic Flow instrument.

*Miscellaneous (see miscellaneous disgn factors list in Appendix A)*

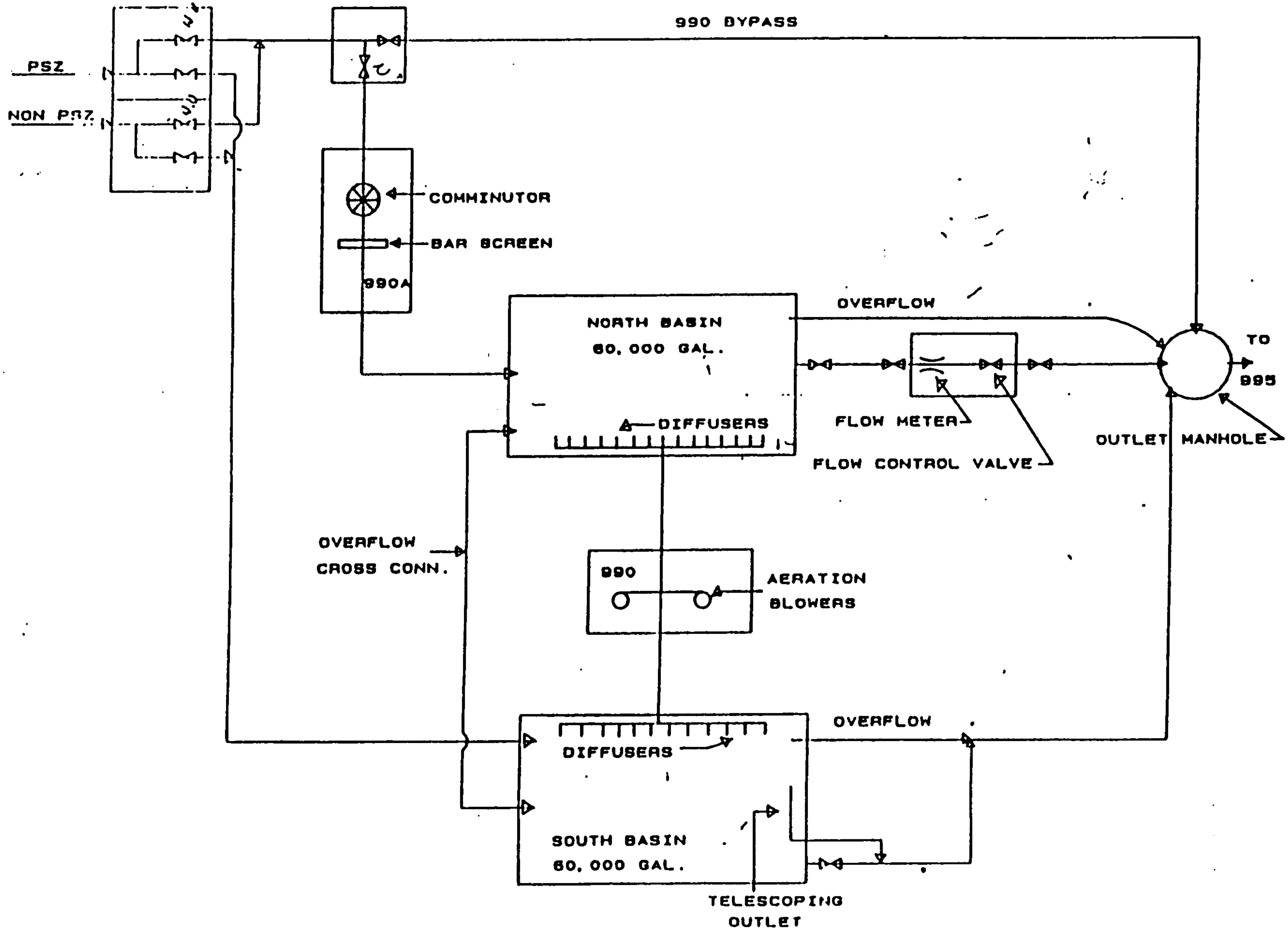
RBD INC
Engineering Consultants

CLIENT AST/RFP JOB NO.
PROJECT STP Evaluation CALCULATIONS FOR
MADE BY BAJ DATE 4/10/90 CHECKED BY DATE SHEET A1 OF A1

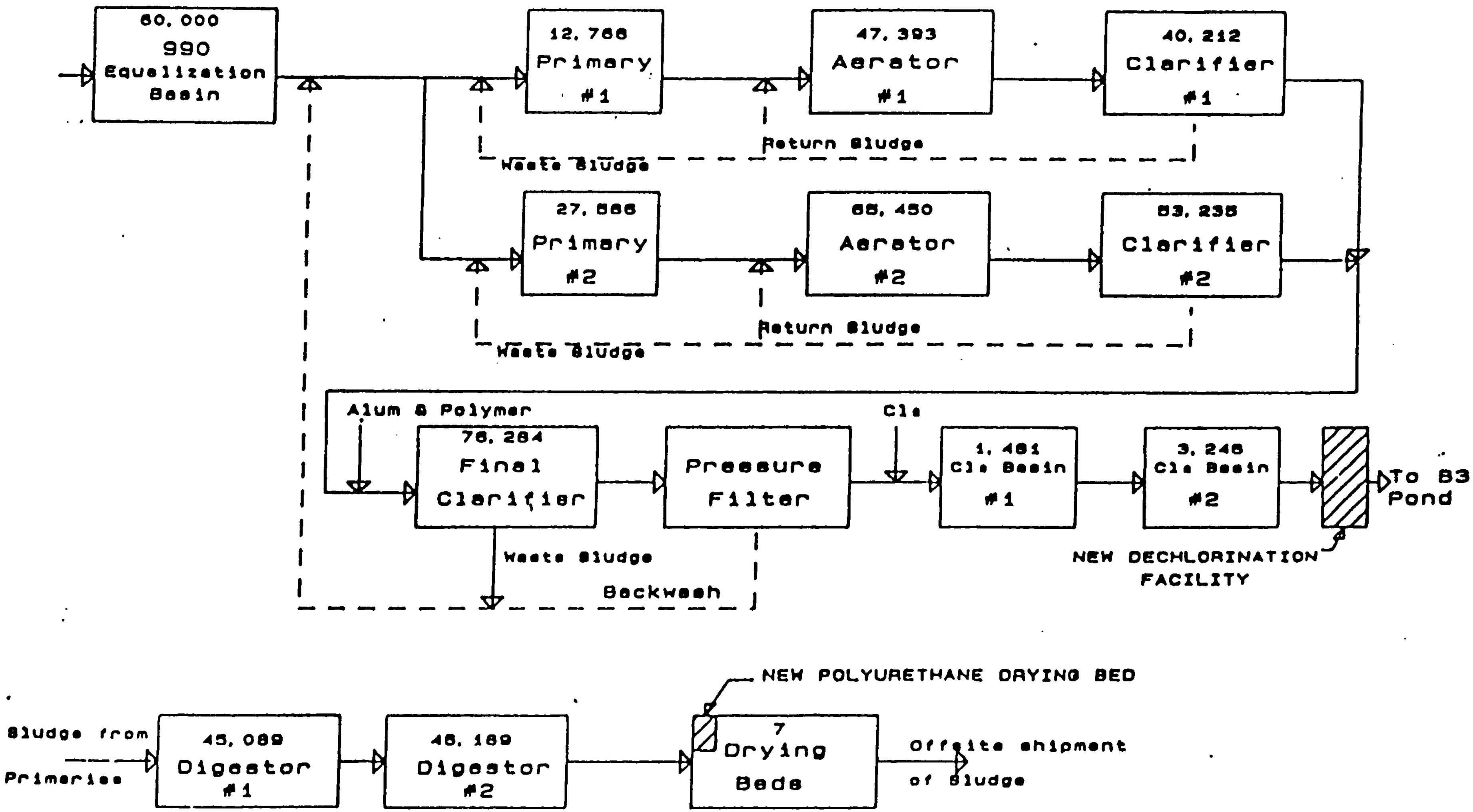
## EXHIBIT A



# BUILDING 99[illegible] BASINS



# Rocky Flats Sewer Plant Flow




NOTE: VOLUMES IN GALLONS

# ROCKY FLATS
# WASTEWATER TREATMENT PLANT
# CAPACITIES AND DETENTION TIMES

APPROXIMATE DAILY FLOWS

WEEKDAYS : 250,000 GPD
WEEKENDS : 120,000 GPD

APPROXIMATE CAPACITIES AND DETENTION TIMES
ASSUMING A FLOW OF 250,000 GPD

990 PREAERATION BASINS, NORTH AND SOUTH

MAXIMUM EACH : 70,000 GALS.
ACTUAL EACH : 58,000 GALS.
DETENTION TIME PER BASIN : 5.57 HRS, ASSUMING BASIN IS FULL TO ACTUAL CAPACITY

PRIMARY CLARIFIERS

#1 : 12,768 GALS. DETENTION TIME : 1.2 HRS. OFR=?
#2 : 27,586 GALS. DETENTION TIME : 2.65 HRS.

AERATION BASINS

#1 : 47,393 GALS. DETENTION TIME : 4.55 HRS.
#2 : 65,450 GALS. DETENTION TIME : 6.28 HRS.

10.83 combined ⇒ $NO_3$
6.28 individual ⇒ no $NO_3$

SECONDARY CLARIFIERS

#1 : 40,212 GALS. DETENTION TIME : 3.86 HRS. OFR=?
#2 : 53,235 GALS. DETENTION TIME : 5.11 HRS.

FINAL (TERTIARY) CLARIFIER

7[illegible]4 GALS. DETENTION TIME : 7.32 HRS.

SAND FILTER BASINS

WET WELL : 4,308 GALS. DETENTION TIME : .41 HRS.
CLEAR WELL : 2,394 GALS. DETENTION TIME : .23 HRS.

TOTAL DETENTION TIMES USING EITHER #1 OR #2 SYSTEMS EXCLUDING
PREAERATION BASINS, AND CHLORINE CONTACT BASINS

USING #1 SYSTEM ONLY : 17.51 HRS.
USING #2 SYSTEM ONLY : 22 HRS.

CHLORINE CONTACT BASINS

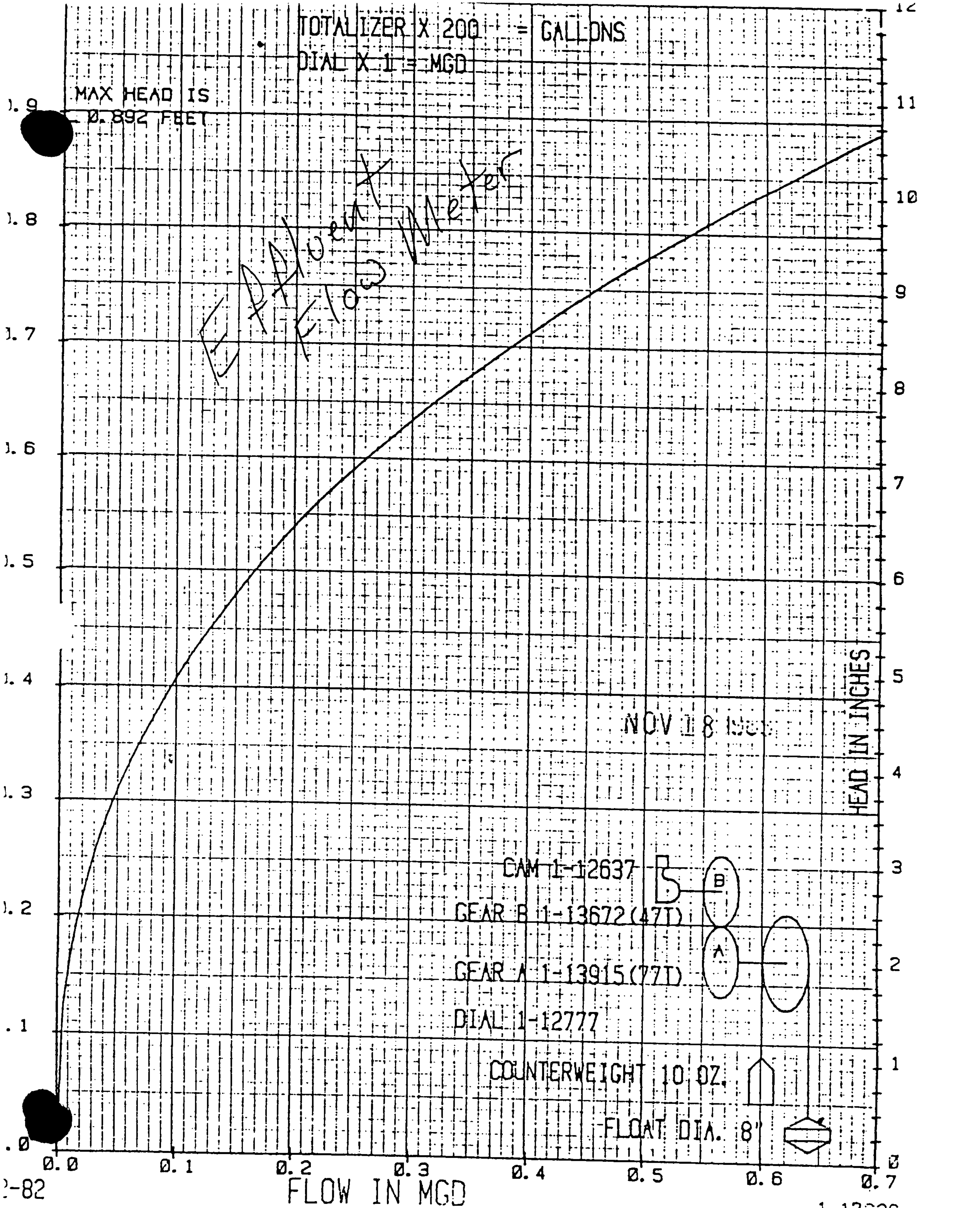
#1 : 1,481 GALS.
#2 : 3,246 GALS.

DIGESTERS

#1 : 45,089 GALS.
#2 : 46,189 GALS.

SLUDGE DRYING BEDS

#1, 2, 3, 5, & 6 DRYING BEDS : 20' X 25' EACH, 500 SQ.FT. EACH
FILLED TO 1' : 3,740 GALS.
#4 DRYING BED : 50' X 37' 1850 SQ.FT.
FILLED TO 1' : 13,838 GALS.
#[illegible]RYING BED : 25' X 37' 925 SQ. FT.
FILLED TO 1' : 6,919 GALS.
TOTAL DRYING BED CAPACITY : 39,457 GALS.


TOTALIZER X 200 = GALLONS
DIAL X 1 = MGD
MAX HEAD IS
0.892 FEET
Effluent
Flow Meter
NOV 18 19..
HEAD IN INCHES
CAM 1-12637
B
GEAR B 1-13672(47T)
A
GEAR A 1-13915(77T)
DIAL 1-12777
COUNTERWEIGHT 10 OZ.
FLOAT DIA. 8"
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
FLOW IN MGD
0
1
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RBD Inc.
MEMORANDUM

TO: RUSS APPLEHANS
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FROM: BRIAN A. JANONIS, P.E.
DATE: AUGUST 16, 1990
SUBJECT: STP TOUR AND EVALUATION

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The purpose of this memo is to identify the performance limiting factors that were observed at the STP.

On August 3, 1990 John Burgeson and Brian Janonis of RBD toured the STP (Building 995). All flow was being run through process train #2. Our observations are summarized in the following memo.

**Preliminary Treatment**

Preliminary Treatment consists of flow splitting, a manual bar screen and a comminutor.

Observations

There is no influent flow metering.

There is no accurate way of splitting flow between process train 1 and train 2. Since each train is of unequal size this is especially difficult to do.

The comminutor does not function well.

**Primary Treatment**

Primary treatment consists of one rectangular primary clarifier for each process train. The clarifiers have been retrofitted with plastic chains and fiberglass flights.

Observations

The clarifiers appeared to function well. As a side note, concrete was spalling from the walls and a repair should be made for structural reasons.

**Secondary Treatment**

Secondary treatment consists of an aeration basin and secondary clarifier for each process train. Both chlorination basins were in use.

#### Observations

A significant factor limiting performance of this plant is aeration capacity. Dissolved Oxygen measurements as low as 0.1 mg/l are being reported in the aeration basin. The surface mechanical aerators are not adequate to handle the oxygen demand.

The plant does not have standby power. When power service is lost so is the aeration and return sludge.

The final clarifiers have circular mechanisms. The center baffle does not have surface ports so scum and foam get trapped in the center well. The operators have observed a hydraulic restriction to final clarifier #1. They think the pipe is too small but no hydraulics have been done to determine this.

### Tertiary Treatment

Tertiary treatment consists of alum, polymer and chlorine addition, a tertiary clarifier, and three pressure sand filters. All of these were in use when we toured the STP.

#### Observations

All equipment appeared to be in good working order.

### Sludge Handling Facilities

Sludge handling includes air lift return sludge pumps from the secondary clarifiers, waste sludge pumping from the aeration basins to the primary clarifier, and waste sludge pumping from the primary clarifier to anaerobic digester #2.

#### Observations

Wasting from the system should be by waste activated sludge pumping from a hopper in the secondary clarifier to the digester and from primary sludge pumping from the primary clarifier to the digester. This would allow an accurate measurement of mass wasted from the system and allow the waste activated sludge to be concentrated in the hopper prior to pumping to the digester.

### Sludge Treatment

Sludge treatment consists of two anaerobic digesters in series, drying on sludge drying beds, and then disposal by hauling to the Nevada Test Site. All facilities were on line the day of the tour. Supernatant was being aerated in aeration basin #1 before being returned to the head of the plant.

#### Observations

The sludge treatment and drying facilities are overloaded. Sludge was everywhere.

The two anaerobic digesters have serious safety problems. The flame arrestor on digester #1 was cracked and the covers were not sealed. there are no provisions to flare methane gas. This will be discused in more detail in a memo to follow.

The digesters do not appear to be operating anaerobically. Flies were seen in the digesters through the observation port. The above mentioned leaks probably cause air (oxygen) to enter the digester.

The drying beds do not have adequate capacity to handle present sludge production. A mechanical dewatering and drying project is underway. Long term plant improvements should address concentrating sludge prior to digestion and adequate digestion. We question the appropriateness of anaerobic digestion for a plant of this scale.

cc:Don Ferrier - EG&G
Bill Burbridge - EG&G
Nick Hart - ASI
Norm Fryback - EG&G
Dr. Mike Richard - CSU